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McGRAW-HILL PUBLISHING COMPANY, Inc.
AUGUST 16, 1917

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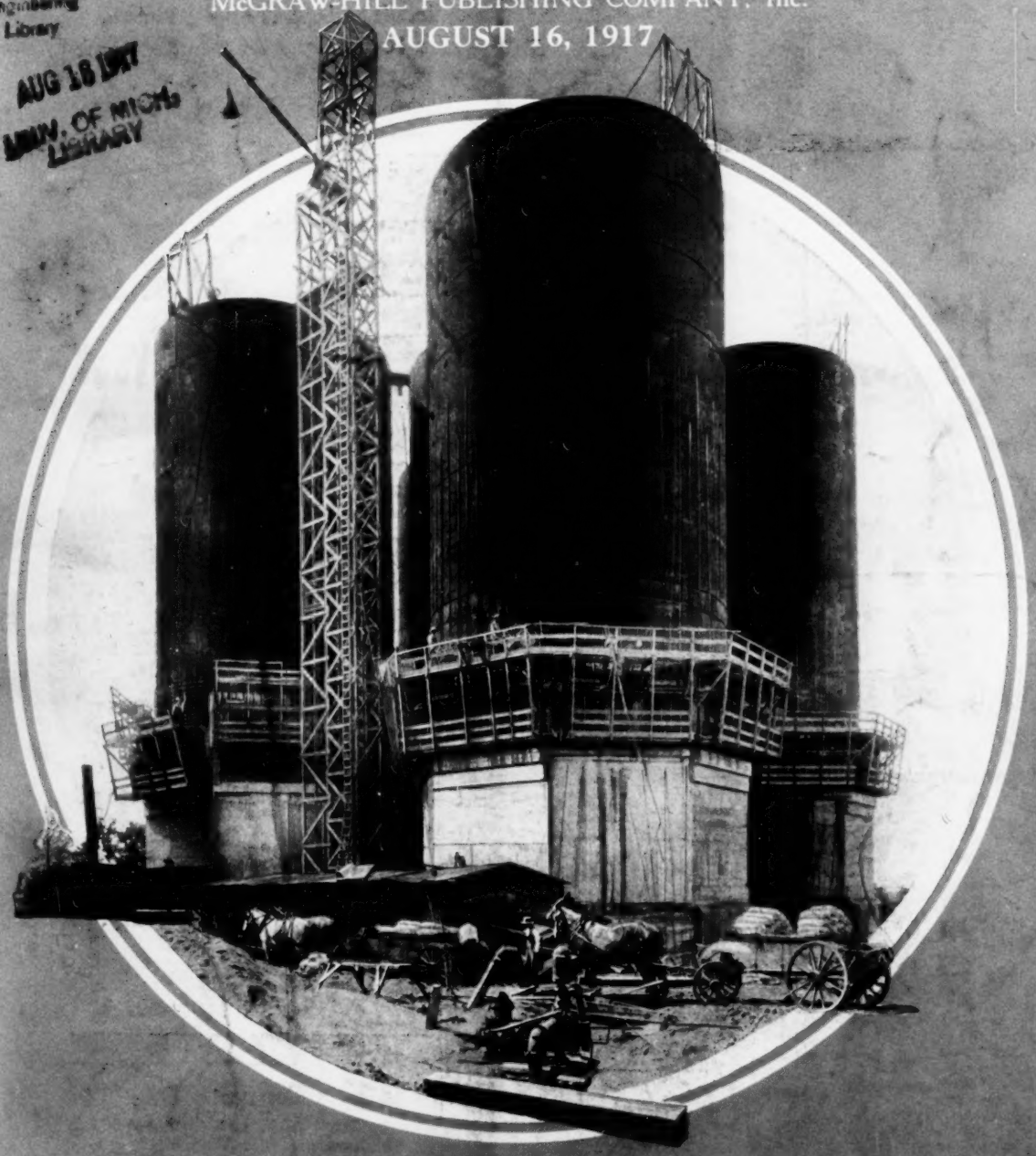
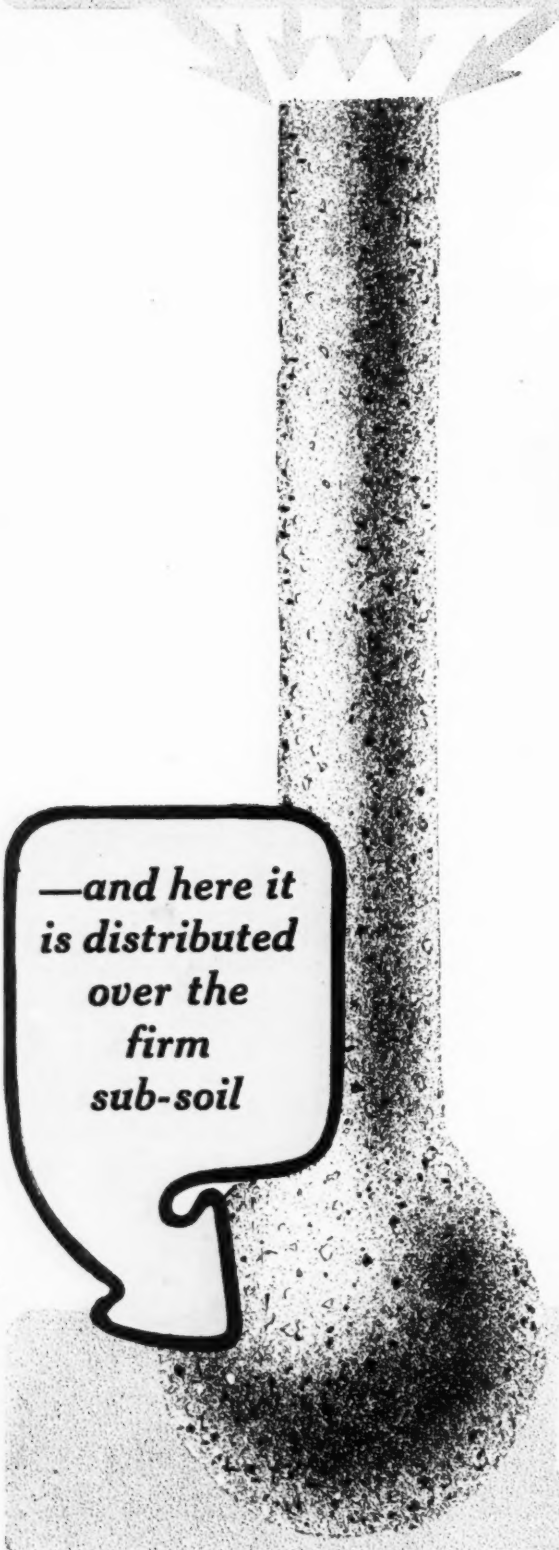


Five Tall Standpipes Encased in Concrete, Using Forms Raised from Floats, Have Been Built at Cincinnati. The Work is Described in This Issue

Cover released by courtesy of Jennison-Wright Co., Toledo, Ohio.

Here the load is applied



Glance at this drawing of a Pedestal Pile. The load is applied at the top of a 16-in. diameter concrete shaft—**and this shaft keeps the same diameter throughout its length!**

At the base of the

PEDESTAL PILE

the load is distributed over the firm subsoil.

But look! The base of the Pedestal Pile is a large concrete bulb—**it spreads out over this subsoil**—it reduces the pressure transmitted per sq. ft.

And that is why "superstrength" is found in the Pedestal Pile—that is why it gives the strength of a grillage at the cost of a concrete pile.

There's a new Pedestal Pile Catalog—filled with important data—just off the press—write for a copy today.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Investigate Water but Provide Water Power

YEARS of fighting for a highly useful purpose reached success with the signing of the River and Harbor act this week. The Newlands section of the act, aimed at ultimate unification of Federal water administration, has been on the carpet for years. Now finally it managed to pass, although in somewhat emasculated form. Whether the ideal end is to be looked for in a Federal bureau of water or in other forms of administration is secondary. The great thing is to make a beginning toward unsnarling the tangle which now binds up the irrigation, power, water-supply, navigation and other uses of water. Under the new law the next few years can only bring forth investigation and report. Meanwhile, one phase of the question—that relating to water power—ought not to wait for the results of this study, and the subsequent delayed action of Congress. Present restrictions on development of water power are so hurtful to the Nation's interests in the pressure of war work that immediate relief legislation should be had. There is no danger that the passage of such legislation will prejudice the results of the Newlands commission's work.

Cautious Progress in Price Regulation

FEELINGS of relief are in order now that both the River and Harbor and the Food Control Bills have become law. The greater relief is to come, however, when the Government's policy and procedure in price-fixing will have been clearly defined. The nation is committed to regulation of prices—that is certain now. It is made more certain by the passage of the Food Control Bill, since no one price can be fixed, safely, without fixing other prices as well. And to safeguard the food situation it is obvious that prices will be fixed. Indeed, the new administrator's first act was to issue a statement containing warnings against excessive prices, and almost immediately thereafter the project of Government purchasing and selling loomed up. Quite generally, the word "profiteering" has been a Washington shibboleth during the week, and it seems to mean asking prices that exceed the production cost by more than x per cent., where x is the as-yet-unknown quantity. There is a bothersome problem in the fact that one producer's rock-bottom price may be a very rich figure indeed for another producer. To date the Government has done nothing toward solving this problem, in spite of much discussion. Pending such solution—and other matters as well—much good business is stagnating, which is not precisely helpful to the country's interests. But we may feel with some comfort that by the Federal Trade Commission's studies and otherwise the price-fixing matter is progressing, though cautiously.

More Map Making in Future—Perhaps

THE leisurely rate at which mapping of our country proceeded in the past was doubtless in part the expression of a feeling that active practical work is more important than drawing maps. It may be that the same sentiment had hold of our military engineers; at any rate we know today how they were caught in the first swirl of war-preparedness work bare of a great many maps necessary to defense. Now comes the experience from every cantonment job that the first urgent need is a topographic survey, adequate maps being not in existence. Thus circumstances are creating a greatly enhanced respect for an ample supply of map information. A logical outcome will be an increase of mapping in all the states, after the war. That would represent a much-to-be-desired advance. As we stood until a few months ago, were there prospect of handling extensive military movements—even if only maneuvering—within the United States on the basis of the Geological Survey's inch-to-the-mile sheets, neither our civil nor our military authorities could be particularly proud of the result.

For Safety Use the Closed-Circuit Idea

THE wider use of automatic fire and other alarms is being proposed here and there over the country, to replace watchmen and thus to relieve in one direction the difficulties expected from shortage of men. And in almost as many instances the employment of mechanical or electro-mechanical devices is opposed on the ground that they get out of order, fail to function when most needed and double the dangers they should reduce. But just such devices have been successfully used for years in many fields, and that criticism fails if the mechanisms embody the "closed-circuit" principle which has become a fundamental requisite in railway signaling—that is, if when they get out of order they give a warn-

ing through this very failure to hold themselves ready for service. A few false alarms will be given, of course, but their number will be comparable with the lapses in judgment of the human minds replaced.

Stealing Estimates from Contractors

SOME corporations in the western part of the country have been abusing the practice of calling for bids on construction work by using the bids received as a basis for making an agreement with some favored contractor, or simply for checking their own estimate as to the cost of work which they have no intention of carrying out at the time. It costs money to submit a bid, and the contractors who are imposed on in this way are forced to charge other owners more for their work in order to save themselves from loss inflicted as a result of this practice. In other sections reputable contractors have from time to time refused to submit tenders to this class of owners, and the offenders have found themselves in the end dependent for their new construction on a few parasites who were in a position to reverse things and make the misguided owners pay anything they might ask. It is rumored that even trunk railway systems have found themselves in this unenviable situation as a result of pursuing this selfish policy. The western contractors propose to combine in refusing to bid on the work of any company that does not agree to announce the result of the letting. This is the proper remedy. It is to be hoped that the western contractors mentioned will not hesitate to apply it and compel a prompt reform.

Fine Screens or Imhoff Tanks?

UPON the outcome of the long contest between fine screens and Imhoff tanks for sewage treatment now hanging in the balance at Cleveland, Ohio, may depend in large measure the near future of fine screening in America. We say "near future," because some features of the later phases of the contest seem more likely to be temporary than permanent in their influence—at least outside of Cleveland. We refer more particularly to the fact that after several years of experiments, first with the whole range of currently available methods of sewage treatment, then with fine screens as an outgrowth of the earlier tests and with activated sludge as a new and promising process, all by a resident consulting engineer and local staff, a second consulting engineer was called in. After a few weeks' study he recommended procedure in some respects in direct variance with the conclusions and plans of the first consulting engineer. The story is outlined and many details of the test results and of the report of the second engineer are given in an article beginning on page 308.

The outstanding engineering facts are: (1) That according to Messrs. Pratt and Gascoigne, fine screens, as represented by the protracted test of a full-sized Riensch-Wurl screen, did not fulfill the promise expressed in the Cleveland sewage-testing station report of 1914 and fell far below the contract-test requirement of being equal to sedimentation tanks in removal of suspended matter; (2) that notwithstanding, in fact one might say almost ignoring, the results of the Riensch-Wurl screen tests, Mr. Fuller advised the use of fine screens instead of Imhoff tanks at all three of the proposed Cleveland sewage-works; (3) Messrs. Pratt and Gascoigne concluded that fine escreens would not remove sufficient solid matter to prevent formation of a sludge mat on the lake bottom, with subsequent loosening and beach pollution, and would otherwise be unsatisfactory as compared with Imhoff tanks and more expensive in total annual charges, while Mr. Fuller believed that the fine screens would do all that is needed at the lake-shore plants, at less annual cost than the proposed tanks; (4) that at the one works where a relatively high degree of treatment is required Mr. Fuller would follow fine screening with sprinkling filters and these with deep Dortmund tanks, instead of using Imhoff tanks as proposed by Mr. Pratt; and (5) that Mr. Fuller, like Mr. Pratt, has high hopes for the future of the activated-sludge process, and Mr. Fuller here, as in an earlier report for Lima, Ohio, believes in fine screens as preliminary to the activated-sludge process.

Time must tell whether Messrs. Pratt and Gascoigne are right in preferring sedimentation in Imhoff tanks to fine screens or Mr. Fuller right in his real or apparent ignoring of the latest Cleveland screen tests and recommending fine screens over Imhoff tanks for clarification.

It must be understood that in the Riensch-Wurl tests and report, a result equal to 1½ hours of sedimentation was the criterion, whereas in Mr. Fuller's report it is assumed that at two of the sites fine screens will afford all the clarification now required and at the other site they will be a useful and satisfactory preliminary to sprinkling filters and deep Dortmund tanks. In other words, fine screens are assumed by Mr. Fuller to be sufficient and preferable to anything else for the general end to be accomplished and are not measured in terms of removal of suspended solids, either absolutely or as compared with some other method.

On the face of the two reports, the earlier one is unfavorable to fine screens from various specific points of view, while the later report is most encouraging for fine screens, but in broad general terms, with few supporting operating data, and after an apparent discard of the Pratt-Gascoigne tests and conclusions.

Technically, at least in so far as meeting Cleveland conditions is concerned, the points at issue are before the Ohio State Department of Health. Its decision will be awaited with interest—an interest heightened by the fact that Prof. Earle B. Phelps, of Washington, has been called into consultation by the State of Ohio. Professor Phelps' connection with the United States Public Health Service and with the International Joint Commission studies of pollution of the Great Lakes

will tend to give the final decision reached a national and an international aspect, from the sanitary but not necessarily from the economic viewpoint.

Reform Due in the Regulation of Joint Committees

SOME very definite regulations are needed governing the conduct and reports of joint committees if these reports are to have the authority which is their main justification. Ostensibly such committees are organized because their reports will realize on all of the talents of the different societies which cover the subject under study. Actually they approach this ideal only in so far as the representatives gage the combined mind of their respective societies. The membership itself has small opportunity for detail changes in the report, which is in effect only the expression of the qualified experts who make up the committee. This is representative government carried to the second degree, for joint-committee members are as a rule appointed by officers who are in turn elected by the membership—and there is no recall.

All of this does not detract from the technical excellence of joint-committee reports. It does mean that under present conditions it is not quite fair to label reports with the names of the contributing societies.

The final report of the Joint Committee on Concrete and Reinforced Concrete is a case in point. That report was printed last December in the *Proceedings* of the American Society of Civil Engineers and presented to that society in January as a report of a special committee. According to established procedure, it was neither adopted nor rejected, but was simply received. In February it was received by the American Concrete Institute, in March adopted by the American Railway Engineering Association and in June accepted by the American Society for Testing Materials. At these later meetings there were present men who either on the floor or in the lobbies urged the impossibility of amending and even of rejecting the Joint Committee report without pronounced discourtesy to the other societies that contributed to it. Even in the American Society of Civil Engineers, which recognizes the report as coming from its own committee, some tactless semi-official criticism of the Joint Committee and of one of the other constituent societies led the chairman of the special committee to refer to the discourtesy of suggesting the discharge of that committee without due notice to the other societies.

Here is built up a vicious circle of courtesy which prevents any society from considering a joint report on its merits. Add to this the fact that the concrete report, presented as new matter to the Testing Materials society in June, had already been in print and extended circulation for six months—duly labeled with the name of the American Society for Testing Materials—so that by that time it had reached the stage of a permanent and accepted document!

The anomalous situation created by the concrete report at the Testing Materials meeting led to a resolution calling upon the executive committee of that society to lay down some rules governing the conduct of all joint committees. Such action may well be considered by other societies. It is evident that if such committees are not to become creations greater than their creators, appropriate rules must be agreed upon. Some arrangement must be made for the presentation of their reports more or less simultaneously to the respective societies. Some provision must be made to prevent publication of the names of any one of the constituent societies as parties to the joint report until such societies have had opportunity to act upon it. Some control of the contents of the report must be vested in the societies themselves.

And lastly, the report should have final publication with the authorized discussion of all the contributing societies, so that its joint reception may be judged as fully as its joint production is guaranteed.

Cost-Plus-Savings Contract for U. S. Engineer Corps

CONTRACT reform traceable to the unusual conditions attending the war is being extended to Mississippi River work done under the direction of the Corps of Engineers, U. S. Army. There has been adopted for this work a cost-plus-25-per-cent. form of agreement under which bids are asked and contracts awarded on a field cost per cubic yard. If the contractor does the work for less than the bid price, he receives half the saving in addition to his percentage of the bid cost. If the work costs more than the bid, the excess will be deducted from the 25 per cent. of the bid cost which the contractor would have received, up to the point where the amount deducted becomes 10 per cent. of the bid cost.

A greater premium is thus put on saving than is the case with any private work of which this journal has been informed. Very economical work should result. On the other hand, the contractor cannot, in the event of unforeseen rises in labor and materials, receive less than field cost of the work plus a fee equal to 15 per cent. of his bid. Thus, no work is apt to be thrown into the hands of a receiver, even as a result of unfortunate circumstances, which is also greatly to the Government's advantage. These percentages are not excessive when it is remembered that absolutely nothing except labor and materials consumed in doing the work is included in the field cost. Even freight and unloading charges on plant are paid for out of the fee. Furthermore, the Government reserves the right to place additional plant on the work at the contractor's expense if progress is not satisfactory.

The experience to be gained with these contract provisions and with those adopted by the Bureau of Yards and Docks of the Navy Department ought to go a long way toward educating the public to the many urgently needed reforms in contract provisions on public work in general.

Two Novel Coal Piers Recently Opened at Port of Baltimore

Both Pennsylvania Plant at Canton and That of Baltimore and Ohio at Curtis Bay Are Radically Different from Any Others on Atlantic Coast, as Well as from Each Other

TWO coal piers, both representing radical departures from anything yet built, and the two totally different from each other, have recently been put into operation at the port of Baltimore. A combination of 4-ton cable cars and traveling loaders on the pier features the plant of the Pennsylvania R.R. at Canton, just east of Baltimore proper. The capacity of this plant is considerably less than that of other older ones, but the terminal is designed especially to serve vessels and barges of every sort in local coastwise business. At Curtis Bay, south of Baltimore, on the other hand, the Baltimore & Ohio had two demands of a conflicting nature to meet. It was desired to load large ships quickly and at the same time to handle small shipments for local vessels of all types without interference with the larger operations. The company therefore decided upon a system of belt conveyors, traveling towers which the conveyors mount, and cross conveyors on the towers. With the system the company can handle 7000 tons of coal per hour—more than any other pier on the Atlantic seaboard—while at the same time small shipments can be handled as they come, with no delay to either operation.

Car Dumpers at Both Plants

At both piers the road cars are emptied by car dumpers—two at the Baltimore & Ohio plant, one at the Pennsylvania—and up to the dumpers the layouts are not dissimilar to those at other terminals, as the general plans indicate. Road cars are pushed over the hump at the entrance to the load or advance yard, and from that point no locomotives are required except to remove the cars from the empty yard. With brakes released the loaded cars run down to the foot of an incline, where a barney takes them to the dumper, after which the empties run by gravity to the "empty" yard. As the "load" and "empty" yards are side by side there are kickbacks to turn the cars back on themselves; at the Pennsylvania plant the cars are turned back before they reach the dumper, while the reverse is the case at the Baltimore & Ohio terminal.

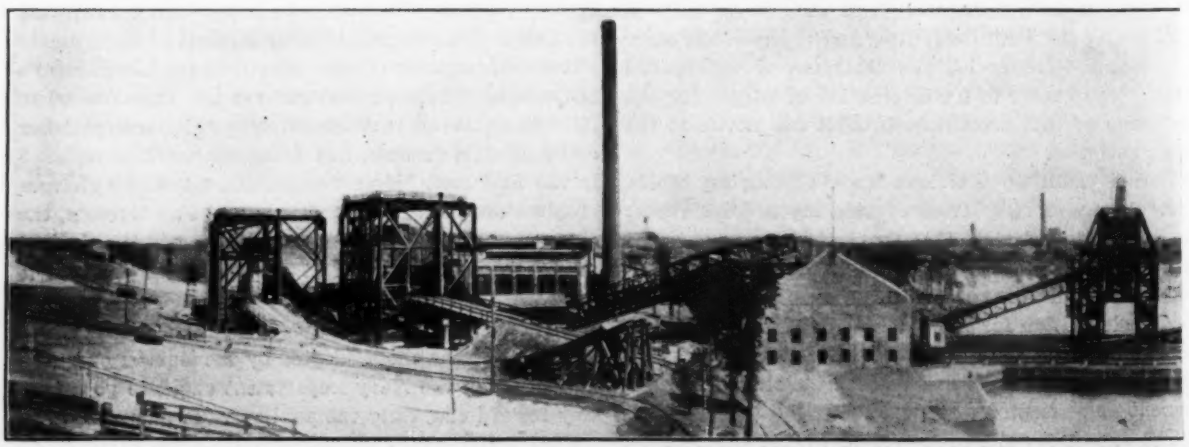
Both roads have thawing houses on the load yards. At the Pennsylvania pier all six tracks pass through the house, which has a capacity of 30 cars. At the Baltimore & Ohio pier the thawing house is over two tracks of the much larger load yard.

The barney at the Baltimore & Ohio pier is of the disappearing type, so that on the return trip it may pass under a car at any point, a movable arm rising up and engaging the car when the barney starts up the incline.

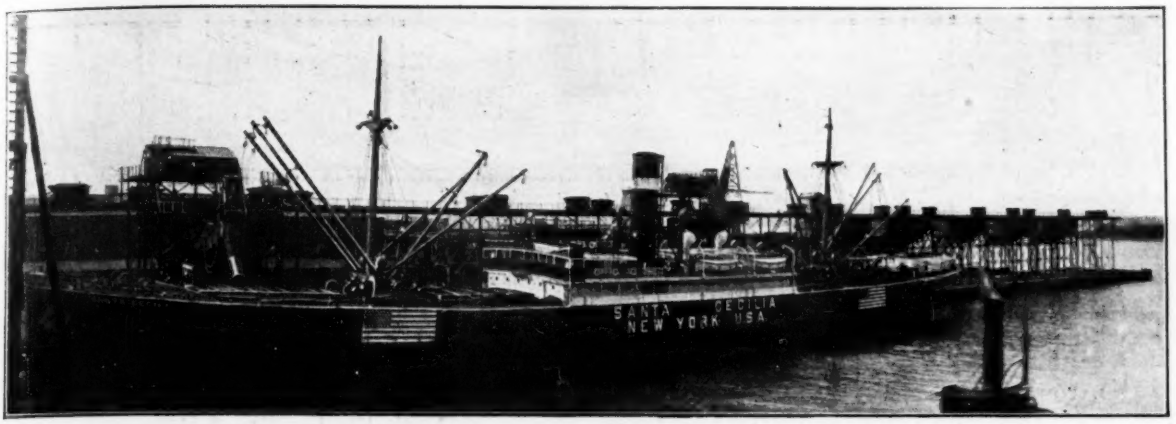
Pennsylvania Uses Small Cable Cars and Traveling Loaders

At the Pennsylvania plant the dumper hopper feeds into 4-ton cable cars traveling on an endless narrow-gage track. The cars are hauled up a 6.72% grade to the high steel superstructure in the center of the pier, whence they pass to the outer end of the pier and back, and down the incline to the starting point. In transit they can be made to deliver their coal to any of the three traveling loaders that constitute the second distinctive feature of the system, or deliver it into any of the bunkers at the outer end of the pier, on the south side. As the photographs show, these loaders are machines moving along the pier on a two-rail track, and carrying a hopper and a chute delivering into the holds of vessels. There are two loaders on the north side and one on the south, in addition to the weighing loader which travels along under the pier bunkers.

As previously stated, the aim in the design of the Pennsylvania pier was to secure flexibility for handling local and coastwise traffic in vessels of every type,



BROADSIDE OF BALTIMORE & OHIO PIER AT CURTIS BAY—



BROADSIDE OF PENNSYLVANIA PIER—LOADER 1, EQUIPPED WITH CONVEYOR, ON LEFT, BUNKERS AT RIGHT

rather than great capacity for bulk shipments. Hence the three loaders are all somewhat different. No. 1, the inner loader on the north side, is the largest and is intended to serve the largest vessels. Its hopper has a capacity of 40 tons, and it is equipped with a pan conveyor on a movable arm, so that the coal can be made to go either up or down to suit the height of the side of the vessel. It has a reach of 34 ft. from the side of the pier and will go over the side of a ship 56 ft. above water level.

No. 2 on the same side has a 10-ton hopper and a gravity chute. No. 3 on the south side has also a gravity chute, but a 35-ton hopper. The gravity chutes must incline about 10° to make the coal move, but can be lowered to a greater angle.

Weighing Loader Serves Bunkers

No. 4 is the weighing loader. It travels along the pier and receives its coal from any of the pier bunkers, of which there are ten, extending for a distance of 625 ft. The weighing loader has a 10-ton hopper and is equipped with a conveyor. The bunkers are each of 75 tons capacity.

The 150-ton bunker at the car dumper has four hoppers arranged in tandem, equipped with a special arrangement by which each hopper delivers one ton of coal to the pier car as the latter passes under it.

The cable system is divided into two parts—one for the incline, the other for the pier superstructure. A tripping device at the top of the incline releases the car from the first cable, and if it is too close to the car ahead it can be held at will until the spacing is as desired. The aim is to have the cars about 60 ft. apart.

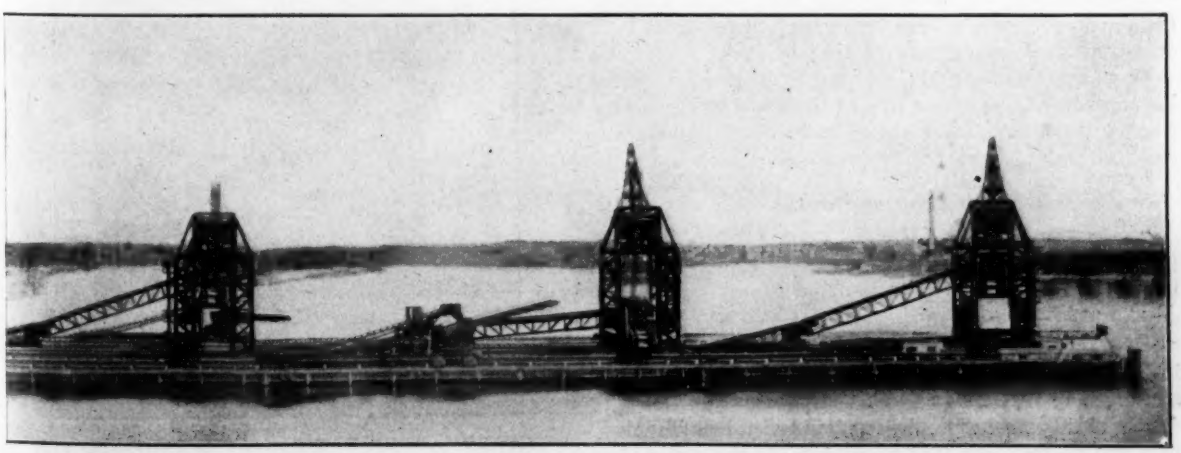
The emptying of the pier cars is centrally controlled from the house at the head of the incline, so that it is impossible for loader No. 1 or 2 to take coal intended for No. 3. The operator in the headhouse in turn has telephonic connection with the operator of the car dumper, so that he may know the proper destination of each car of coal.

The pier is 1000 ft. long and 66 ft. wide. The present capacity of the plant is 1500 tons per hour. By the addition of more cable cars this capacity can be doubled without changing any of the other units.

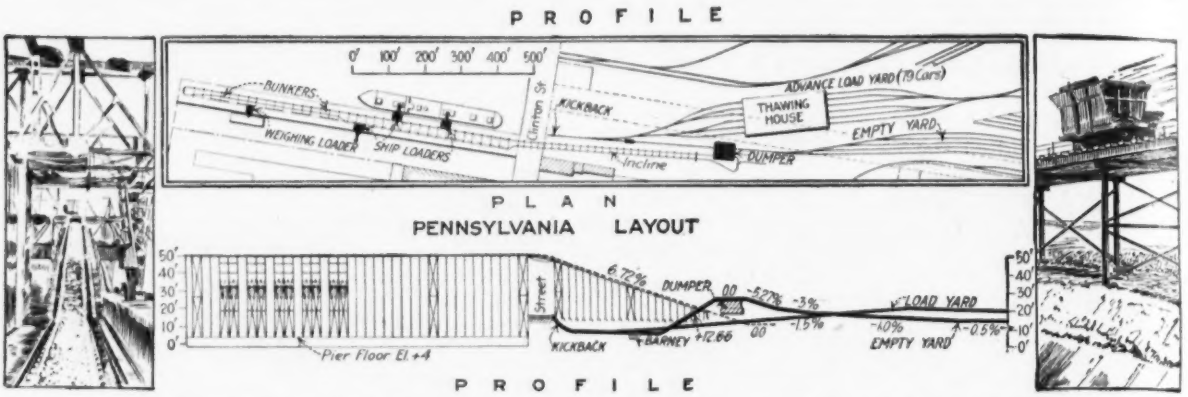
Belt Conveyors at Baltimore & Ohio Plant

At the Baltimore & Ohio pier the need for maximum capacity for bulk export shipments by the car load, as well as for the greatest flexibility, and the desire to minimize the breakage of the coal, led to the adoption of the conveyor system to be described.

Each car dumper empties into a lowering bin, a hopper under which supplies three short feeder belts. Two of these for each dumper feed the main 60-in. loading

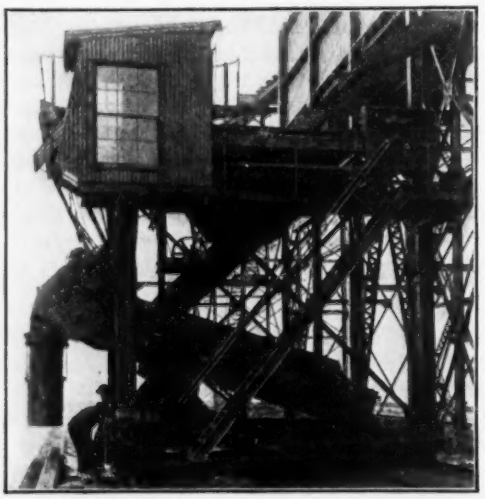


CAR DUMPERS AT LEFT—LOADING TOWERS AT RIGHT



LAYOUT OF PENNSYLVANIA PLANT AT CANTON—POSITION OF CABLE TRACK, LOADERS AND BUNKERS

belts and pass the full length of the pier. The third delivers to another conveyor carried on an inclined bridge. The lower end of this bridge pivots at the discharge end of the short conveyor, while the support near the center travels on an arc of circular track, so that the conveyor can be discharged at any desired point in what is called the balancing bin at the shore



WEIGHING LOADER, TO SERVE BUNKERS AT CANTON, HAS PAN CONVEYOR

end of the pier. Thus there are four 60-in. loading belts and over them a large balancing bin fed from two conveyors on two inclined rotating bridges.

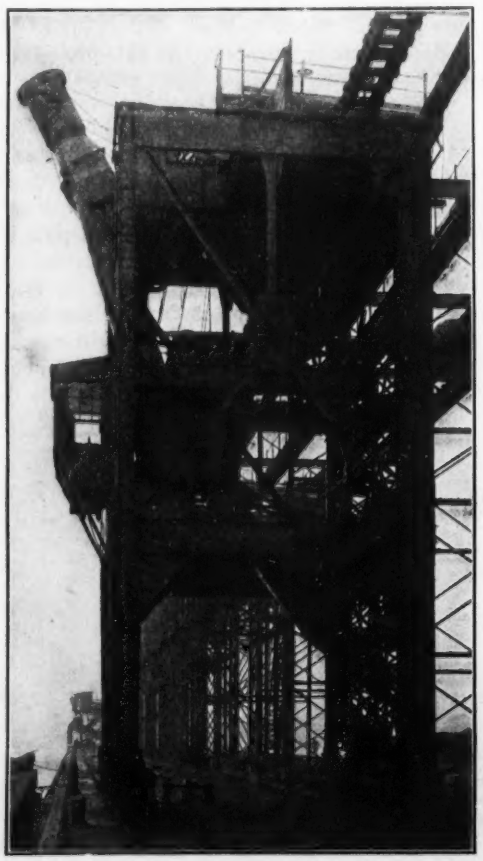
From the balancing bin, and fed by it, run two more belt conveyors, one either side of the main belts, on the edges of the pier. These are 48-in. belts and are known as the trimming belts.

Four Loading Towers

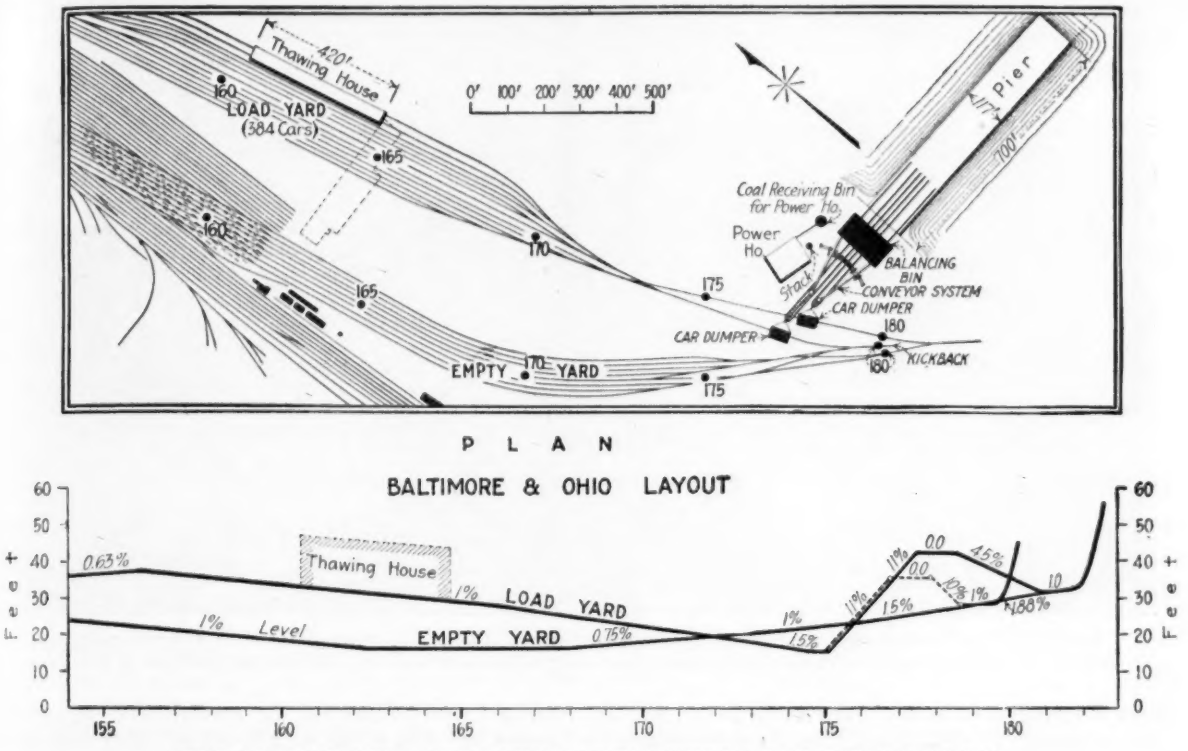
Corresponding to each of the main belts is a loading tower. The four towers are similar, being traveling bridges spanning the main belts and carried on a track system between the loading and trimming belts. Each tower, however, takes the coal from one belt only. An incline at the shore side of the tower takes the belt up and discharges it upon a cross conveyor or shuttle ram on the bridge, whence the empty main belt doubles back and passes under the tower, on out to the end of the pier and back to the dumper. The most southerly belt serves the inshore tower, the next belt the next tower, and so forth.

The cross conveyor has three kinds of motion. The belt can be run in either direction to load ships on either side; the conveyor frame can be moved longitudinally so that the belt will discharge 35 ft. beyond the side of the pier, and it can be raised and lowered within a range of 27 ft. to conform to the height of the vessel, the incline for the main belt being raised accordingly.

In a similar manner each trimming belt serves a trimming tower, there being one on a special track on each side of the pier. The belt passes up an incline on the



GRAVITY LOADER 3 AT CANTON IS DESIGNED FOR OPEN-TOP BOATS



TRACK ARRANGEMENT AND PROFILES AT BALTIMORE & OHIO PIER, CURTIS BAY

tower and discharges into a hopper, which in turn feeds a conveyor on a swinging boom. The name of the trimming towers tells their purpose.

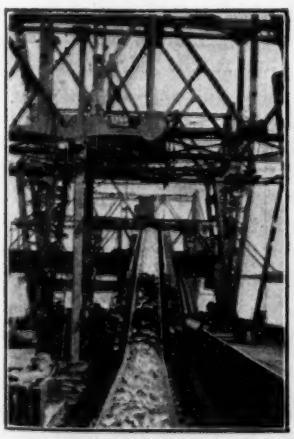
The object of the balancing bin is also implied in its name. Normally the bulk of the coal delivered by the car dumpers is handled by the main loading belts. During the moving of the towers from one hatch to another, however, when these belts are unable to take the coal, it can be diverted into the 5000-ton balancing reservoir, and the dumping of cars need not stop. Conversely, two of the four main belts can be fed from the balancing bin in case the dumper is not working. The trimming belts, also, are fed from the balancing bin.

To prevent the breakage of coal each dumper empties into a 120-ton lowering bin or pan, which is pulled up during the dumping to a horizontal position minimizing the fall of the coal. The pan is then lowered to an angle of 50° and a gate over the hopper automatically opens. At the same time the feeder belts start. When the pan is raised the gate automatically closes, and the feeder belts also stop automatically before the 15-ton hopper is empty. Thus there is always a cushion to receive the coal from the lowering bin.

Operations Automatically Interlocked

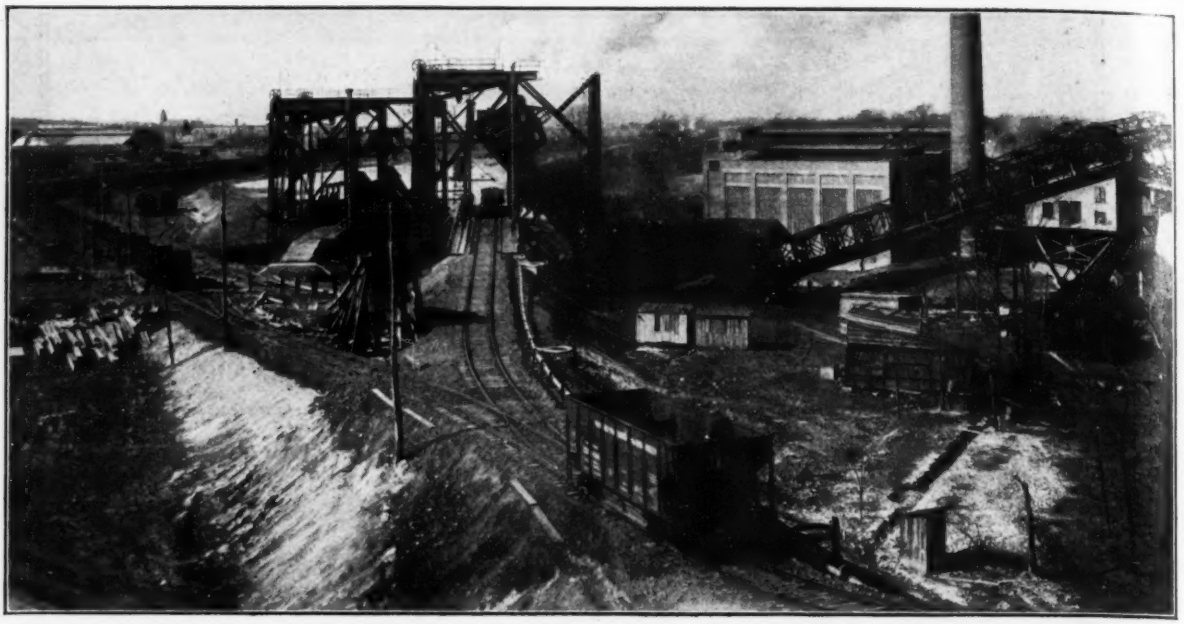
Coal can be taken from the hopper by any or all of the feeder belts at any time.

The balancing bin is divided into eight units—four trimming hoppers with 750 tons capacity each, and four storage hoppers of 500 tons each. The latter, as shown,



BELT CLIMBING TOWER

TWO LOADING TOWERS AND ONE TRIMMING TOWER (AT LEFT) WORKING ON ONE SHIP AT CURTIS BAY



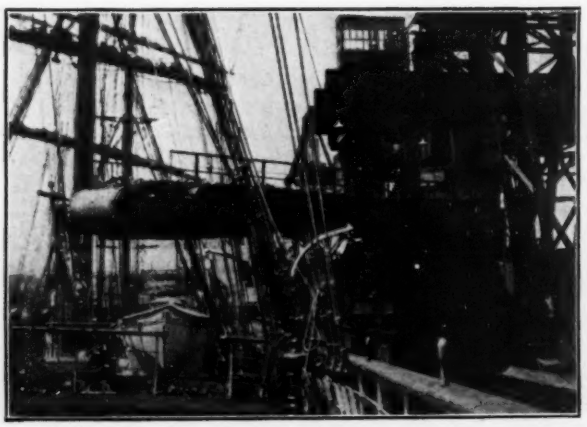
DUMPERS AND INCLINED CONVEYORS AT CURTIS BAY PIER BEFORE COMPLETION OF SECOND DUMPER
One car at kickback, second on dumper, third coming up barney incline; minimum interval between cars timed at 43 seconds

feed the middle two of the four loading belts. The discharge gates of the balancing bin are controlled from the various towers.

The operation of the belts for any given unit is automatically interlocked to render the flooding of a belt impossible. When a unit—belt and tower—is put into operation the shuttle belt starts first, the main belt starts about three seconds later and the feeder belt starts after that. Thus each belt attains full speed before coal is delivered to it. When the unit is stopped the belts stop in reverse order.

All belts have three speeds—250, 375 and 500 ft. per min. The purpose of this is to permit the proper handling of the various grades of coal to prevent breakage. The speed is absolutely controlled by the superintendent of the pier.

The entire plant is electrically operated. Subject to this speed control, and to emergency buttons every 20 ft. along the conveyors, by which the machinery can be stopped, but not started, the operation of each unit is controlled from a cab on the tower. This control includes the movement of belts, shuttle rams, trimming boom and the towers themselves.



TRIMMING BOOMS GET INTO SHIP RIGGING WITH EASE

One of the photographs shows the facility with which the trimming towers work in the midst of the rigging of ships. The booms are 45 ft. long to permit the delivery of coal to the far bunker hatches. They rotate through 180° and have a vertical movement of 57°.

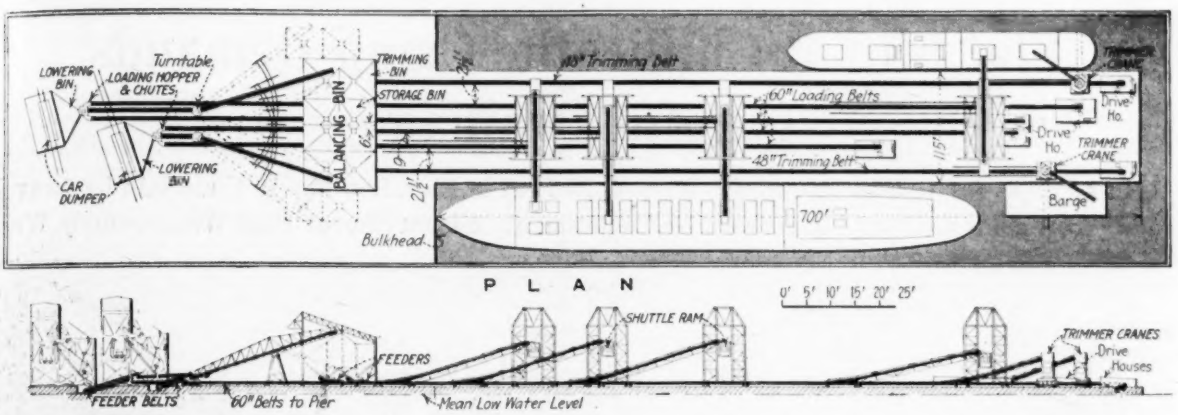
Belt Drives

The belt drives are located at the far end of the pier. They consist of two drive pulleys, operating as a tandem drive, and a third pulley on a sliding frame provided with counterweights. This arrangement is necessary for such long belts to take their slack in starting and maintain an even tension during operation, in spite of temperature variations and uneven loading.

An auxiliary device planned for the loading towers, but not yet installed, is what is known as a "lowerator," a vertical bucket conveyor which would receive the coal discharged from the shuttle ram and lower it directly into the hold of a vessel, thus further lessening breakage.

The total capacity of the pier is 7000 tons per hour. With 12 men one unit will load a 7000-ton vessel in 3 or 3½ hours. This compares with 7½ hours at the old trestle, with 75 men. More than one unit, however, can work on a ship, as each tower has the range of the whole 700-ft. pier, except at the ends, where widths of about 35 ft. for each unit limit the travel of each other. One of the photographs, in fact, shows two loading towers and a trimming tower all working on the same ship.

The equipment for the Pennsylvania pier at Canton, including the car dumper, cable railroad and the various traveling towers, was furnished and installed by the Mead-Morrison Manufacturing Co., of Chicago. The



EACH TOWER OF BALTIMORE & OHIO PIER HAS ITS PARTICULAR BELT

work was done under the direction of A. C. Shand, chief engineer of the Pennsylvania R.R., with J. W. Craig, assistant engineer in immediate charge.

The belt-and-tower installation at the Baltimore & Ohio pier was designed by and has been patented by F. L. Stuart, consulting engineer, of New York City, and formerly chief engineer of the Baltimore & Ohio. The machinery was built by the McMyler Interstate Co., of Cleveland, which also furnished the car dumpers. The Robins Conveying Belt Co., of New York, furnished the belts. The pier and equipment were built under the direction of Mr. Stuart and his successor, R. N. Begien, more recently chief engineer of the Baltimore & Ohio, assisted by W. S. Bouton, engineer of bridges; M. A. Long, architect and assistant to chief engineer, and J. T. Wilson, district engineer. Fred C. Thornley, of New York, was retained by the railroad as consulting engineer on the improvement.

Sacramento Creates Engineering and Street Departments

City Engineer and Superintendent of Streets Head Departments—Qualifications, Duties and Salaries Defined

A DEPARTMENT of engineering headed by a city engineer and a street department headed by a superintendent of streets were created by ordinances of the City Commission of Sacramento, Calif., passed on July 5. The two departments appear to be quite independent of each other.

The city engineer is appointed by and holds office at the pleasure of the city commission. He must be "a civil engineer of at least five years' practical experience as such." He exercises all the powers and duties provided for by state law or municipal ordinance. He is authorized to appoint, and to remove at pleasure, a deputy chief engineer, a chief draftsman, a secretary; also to appoint from time to time assistant engineers, surveyors, rodmen, extra draftsman and inspectors as the City Commission deems necessary.

Qualifications of Deputy City Engineer

The deputy city engineer "shall have been employed in the practice of civil engineering at least three years prior to his appointment and shall possess a practical working knowledge of material and methods of construction commonly employed in municipal engineering, and be qualified to superintend the construction of ordinary municipal engineering works and structures." The chief draftsman must have had three years' experience "in the preparation of drawings intended for use in civil or mechanical engineering or in architectural structurals."

The following scale of annual salaries is provided: City engineer, $3600; deputy, $2100; chief draftsman, $1500; secretary, $1200. Temporary assistant engineers or surveyors get $150 a month, or $6 a day for periods of less than 25 days; inspectors and draftsmen, $4; rodmen $3.50. All the officers named except the city engineer, rodmen and inspectors "are declared to be professionally educated persons or experts within the meaning" of the charter.

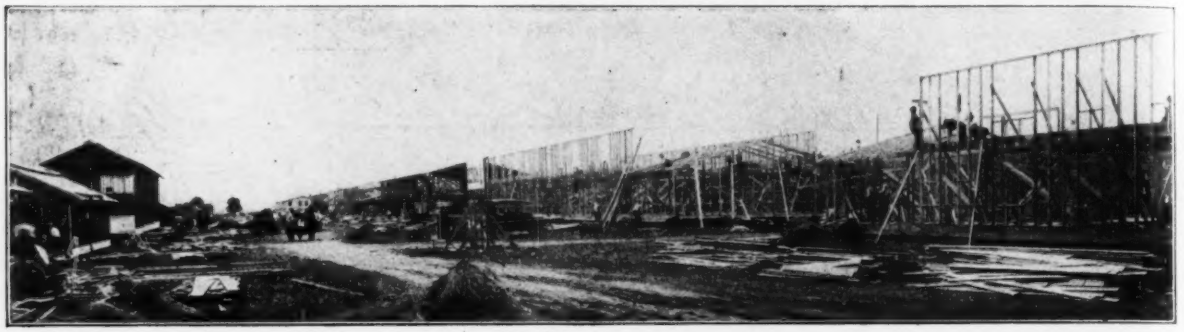
Organization of Street Department

The superintendent of streets receives $2700 a year. He appoints and may remove at pleasure an assistant at $1500, who shall serve as chief deputy; a foreman of streets and sewers at $1800; a permanent street improvement clerk at $1620; two field engineers at $1800; an assessment clerk and two draftsmen at $1248; four rodmen at $3.50 each, besides such additional deputy superintendents of streets and additional employees of the other classes named, laborers and inspectors as he shall deem necessary. Inspectors are paid $4 a day. Temporarily employed engineers and surveyors get $6 a day, but not over $150 a month.

Bonds must be given to the city as follows: Superintendent, $10,000; assistant superintendent and foreman of streets and sewers, $5000 each. These three subordinates, together with all field engineers, all engineers and surveyors and all draftsmen, are classed as "professionally educated persons or experts" within the meaning of the city charter. With the consent of the Civil Service Board the foreman of streets and sewers may be exempt from the civil-service provisions of the city charter.

Flat Site at Chillicothe Camp Demands Careful Drainage

Area of 1900 Acres Has Extreme Range of 25 Feet in Elevation but Is Underlain by Gravel Bed—Cornfields Quickly Converted Into Cantonment—Steam Shovel Digs Water-Supply Well



By NATHAN C. ROCKWOOD
Associate Editor, "Engineering News-Record"

THE FLAT 1900-acre site selected for Camp Sherman, the national army cantonment at Chillicothe, Ohio, presented few topographical obstacles to rapid construction, but required a comprehensive system of drainage ditches to convey the runoff from the buildings and paved roads to the Scioto River. The big expanse of cornfields made ideal stamping-grounds for a herd of trenching machines, and both the sewer and water systems were laid out for relatively shallow ditching to take advantage of this condition. The gravel stratum underlying the site is waterbearing, and a well, the first 20 ft. of which was dug with a steam shovel, will tap this source to furnish water for the camp. The building work, highly organized, has progressed with great rapidity.

Drainage Ditches for Unusually Level Site

The Chillicothe cantonment is laid out with regimental streets perpendicular to a main U-shaped artery embracing the parade ground, through which runs the intercounty highway from Chillicothe to Clarksburg. The entire camp site lies between elevations 625 and 650 ft. above sea level, while the Scioto River, which approximately parallels the main arteries of the camp at a distance of about half a mile, is 600 ft. above sea level at normal flow. Fully 95 per cent. of the camp site proper is above elevation 635 and below 650. From this a conception of its ideal topography may be gained. Under ordinary conditions such a level plain would have many undesirable features from a drainage and sanitary standpoint, but in this instance the whole site is underlain at a depth of but a few feet with a bed of river gravel and sand, so that natural subdrainage under conditions of cultivation is almost perfect. But with the 1200 buildings to be erected on the site and with several acres of paved streets, the runoff factor becomes serious, and elaborate plans have been made for surface drainage.

A FOUR-MILE INDUSTRIAL RAILWAY HELPS TRUCKS

Near each outside longitudinal boundary of the camp is a large open drainage ditch from which the water is removed by natural channels to the river. These ditches are built on grades of approximately 0.08 per cent. and their maximum cross-section is 72 sq.ft. It is intended to protect them from scour with brush revetment. Each block of buildings drains into gutters and small ditches and thence to the main drainage ditches. The character of the subsoil is such, however, that little or no water will ever stand in the latter.

The same gravel contains the camp water-supply. Wells have been sunk all over the site and water thus obtained for the construction needs. For the permanent water-supply of the camp, a well 70 ft. deep is being sunk about half a mile northeast of the center of the camp. For the first 20 ft. a steam shovel is being employed for excavation. Steel sheetpiling is then to be driven and the remaining excavation will be made by clamshell bucket. Three pumping stations and necessary storage tanks are to be built to supply the camp.

All the water mains, with the exception of 1800 ft. of 12-in. suction and force mains from the well to the pumping station and tanks, are of California wire-wound wood-stave pipe. The principal main is 14 in. in diameter and 3060 ft. long. There are nearly 75,000

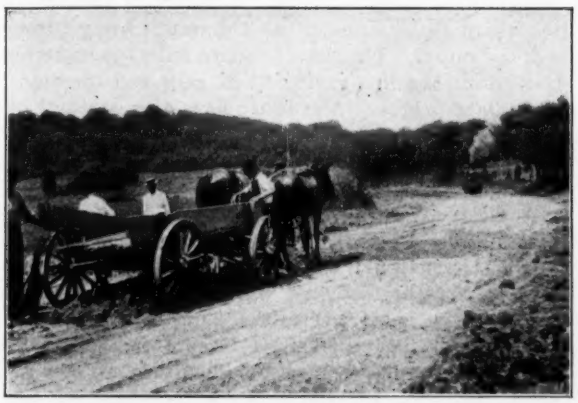
ft., of sizes from 10-in. to 6-in. The water-works system, owing to the simplicity of the camp design, is merely a rectangular gridiron, both sides of the encampment being practically identical.

The water is of excellent quality, but somewhat high in iron content, so that it becomes cloudy on exposure to the atmosphere.

Sanitary Sewers Drain to Septic Tank

The sewerage of the encampment is to be taken care of by two main trunk sewers of 24-in. pipe, on the east and west sides respectively, connecting at the southern end of the cantonment with a 30-in. outfall sewer leading to a simple septic-tank treatment plant a mile below, whence the sewage is to be pumped through a 20-in. vitrified-pipe main 2500 ft. long to the river bank. The joints of the vitrified pipe are to be filled with a bituminous material. From the river bank to the channel outfall there are to be two lines of 16-in. Universal joint cast-iron pipe.

Another proof of the ideal topographic conditions is the fact that the construction work has proceeded without a hitch with no accurate topographic map as a guide. On June 18 not one bit of work had been done on this site. A topographer from the United States Geological Survey came about this time and made a hand-level contour survey under the direction of R. Winthrop Pratt, consulting engineer, of Cleveland. From this the main drainage scheme was laid out. On June 21 the site was approved and the contract was awarded. On June 29 a revised camp layout was finished on the scanty survey data gained in the interim. During these ten days the consulting engineer also developed the water-supply system.



GRAVEL ROADS BUILT BY LOCAL CONTRACTORS

On the first of July the location of the water-supply well had been established, also that of the sewage-disposal plant and of the main roads, and the methods of road construction were decided upon. Since July 1 the building work has proceeded at such a pace that there is no question but that the barracks will be ready before the time set.

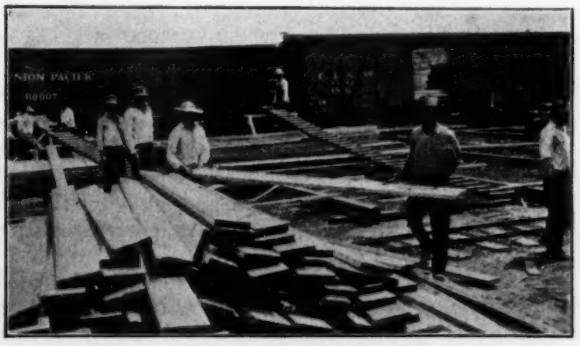
Until July 6 the work on the camp was organized and carried out by Captain T. Eckford Rhoades, an engineer reserve officer detailed as acting constructing quartermaster. Captain Rhoades was previously vice president of the Whitney Co., engineering and architectural contractors, New York City; and in no small degree the impetus given construction during his period of command has had its influence in permanently speeding up the work.

DRAINAGE HANDLED BY OPEN DITCHES

The rapid-fire construction work done by the contractors bears the impress of the personality of the general superintendent, C. H. Hollingsworth. Under him the contractors' organization consists of 14 department heads, responsible to and in constant touch with the general superintendent. These include a general foreman of carpenters, an office engineer, J. C. LeDuc, a traffic manager, a purchasing agent, an accountant, transportation superintendent who supervises all the unloading and camp delivery work, an electrical engineer, a field engineer, who looks after all the building layouts and the staking out of sewer laterals and water-works services, a sewer and water superintendent who supervises the installation of all sewer and water mains, a superintendent of employment, sanitary inspector, a garage superintendent, a general storekeeper and a commissary chief. Under the general foreman of carpenters are five foremen, who on July 23 had 68 sub-foremen, 1300 carpenters and 300 laborers on the job.

Efficient Handling of Construction Material

Transportation within the camp is further looked after by a separate and distinct official known as the distributing agent, who is under the authority of the general foreman of carpenters in his general duties.



ROLLER-CONVEYORS SPEED LUMBER HANDLING

SAWMILLS CUT TO STANDARD UNITS

The lumber arrives on railway sidings at about the middle of the east side of the cantonment. It is unloaded and handed directly to a series of sawmills, where it is all cut into standard units. From these mills it is loaded on industrial railway cars, motor trucks or wagons, and taken west, north or south to the proper camp unit. A four-mile industrial railway, operated by three gasoline locomotives, is an important element in expediting the work, for it releases the trucks of the Quartermaster Department and hired motor trucks for other work. Within about three weeks the contractor has not only completed some of the barracks, but has been able to prepare the new buildings for immediate occupancy by some Ohio State troops. During the last week of July the army motor trucks were being used as much for carrying the Army Commissary Department supplies as for the contractors' purposes.

How Engineering Work Is Organized

R. F. McDowell, resident engineer, has been associated with the consulting engineer, R. Winthrop Pratt, for a number of years. Under the resident engineer are a water engineer, a sewer engineer, three road engineers, one of whom is an employee of the United States Office of Public Roads and Rural Engineering, and a surface drainage engineer.

All the surveying work for any purpose whatsoever is in charge of one man. Under his direction seven survey parties are constantly in the field. These survey parties consist of from one to three salaried men, the rodmen, chainmen, etc., being engineer troops from Company D, Ohio National Guard.

Several Construction Contracts

The work is actually being done under five contracts. One contract, however, with the A. Bentley Sons Co., of Toledo, Ohio, covers the construction of everything but the roads and the water-supply well. Small sections of the work are being done under minor contracts with A. S. Hecker & Co., of Cleveland, Ohio, for the well, and with the local gravel road contractors for distinct pieces of the road work.

The road work consists chiefly of a detour road to divert all traffic from the Chillicothe-Clarksburg turnpike, which runs through the camp, and two main camp arteries parallel to the turnpike and on either side of it. All these are built of the local gravel which underlies the whole camp site and are to be given a surfacing of bituminous material. The detour road is 7600 ft. long and 20 ft. wide, and the two main camp roads are 1300 ft. long each and 18 ft. wide.

The A. Bentley Sons Co. is represented on the job by Thomas Bentley, president, James Bentley, vice president and general manager, and R. B. Daudt, chief engineer.

The Constructing Quartermaster in command of the cantonment is Captain Ward Dabney, U. S. A., and his engineering assistants are Captains Rhoades and Colman, U. S. R.

Railways Help Cantonment Builder Overcome Handicaps

Central Freight Agency for Railways at Des Moines Enables Interurban to Handle Heavy Tonnage Expeditiously

TRANSPORTATION and labor were the two factors most difficult of solution in building the Camp Dodge cantonment, 11 miles northwest of Des Moines, Ia., where 45,000 men for the Thirteenth Army Division will be trained. The site (7 square miles) is on an electric interurban line having 65-lb. rails and correspondingly light bridges. The latter have been strengthened to carry small switch engines. These engines haul to camp at night the cars assembled in Des Moines the preceding day by the half dozen steam roads.

A week after the contract was signed (June 22) orders came to shut down everything until Central Headquarters could check up the water supply and sewage disposal facilities, which a rival city claimed could not be made adequate. This delay required a reduction of the contractor's force from 900 to 300, and naturally discouraged the hundreds of men who were already on the way and reached the camp when men were being turned away. In consequence the contractor had to advertise and use labor bureaus freely.

Campaign Brings Results

The results of this campaign were beginning to show July 26 when a representative of the *Engineering News-Record* visited the camp. A net gain of over 150 men per day was being made and the total had increased to 2200. Only a few hundred of these men were kept overnight in the barracks, most of them returning to Des Moines by special cars loaned to the interurban line by various railways.

The 5-day delay also put all material orders at the end of the list for the 16 cantonments in the country. The order for the 24,000,000 ft. of lumber was split one-third each to the hemlock, the southern pine and the Pacific Coast fir associations. As the hemlock people were unable to make deliveries their share was distributed to the other two associations. About 80 cars of material of all kinds were set in on the above date. In one day, 1,890,000 ft. of mixed lumber was unloaded.

Handling the freight has been reduced to a workable system by the coöperation of the railways with the camp officials. A central agency in town is sup-

plied by each railway every morning with information as to what cars for the camp are in Des Moines. This information is telephoned to a division engineer in camp at 10 a.m. He goes through the list and makes up a "spotting" schedule which he telephones back at 3 p.m. to the central agency. The agency turns this over to the interurban company to carry out during the night.

During the day the cars are assembled in proper order on sidings along the interurban tracks. The trains are therefore practically made up in proper order for setting out at the camp. A few distribution switches already existed near the storehouse of the Iowa National Guard (included in the camp site), but 3 miles of permanent track had to be built and 3 miles of temporary track for sidings 200 ft. from the building line.

In unloading it is aimed to handle those nearest the main line first, but at 4 p.m. an inspection is made to push along the work on the partially unloaded cars so as not to have many cars half unloaded. However, about 20 unloaded cars are retained overnight, so that if the night switching should not be done for any reason, there would still be work for the men next day.

Materials had come in such quantities by July 26 that an additional 1000 men (half carpenters and half laborers) could have been employed to advantage. It is planned to increase the number to 5000 or 6000 if possible. A month after the contract was signed, 115 buildings were under construction, of which 45 were practically completed. By Aug. 1, 36 additional barrack buildings had been completed.

Camp Site Ideal

Topographically the camp site is excellent, and the layout follows closely the ideal plan sent out from Washington. It is located on the west side of a narrow ridge forming the watershed between the Des Moines River and Beaver Creek. The line of barracks forms a hook, with headquarters near the center at the bend of the shank. A concrete road, 20 ft. wide and 3 miles long, will serve as the main street, and there will be 4 miles of gravel road and 8 miles of graded streets.

Gravel comes from a pit 6 miles away equipped with screening, washing and loading facilities for supplying 50 cars per day. About 15,000 yd. will be required. The sand is unloaded by clamshell buckets to a fleet of 6-ton White motor trucks with wide tires, 1½-ton army trucks (sent up from the Mexican border) and also wagons. The greater part of the short haul of lumber and other materials is done by teams direct from cars to the barracks.

Water Supply from a Large Well

A well 60 ft. in diameter and 33 ft. deep is being sunk on property belonging to the state. It is in a gravel bed 16 to 24 ft. thick and overlain with a loam cover of the same depth. A circular concrete shell in 8-ft. sections is being excavated by a steel stiffleg derrick operating a clamshell bucket. There will be three electrically driven pumps, each with a capacity of 1000 gal. per min. against a total head of 250 ft. (200 ft. static head). These will discharge through 4460 ft. of 16-in. wood pipe into a 1,000,000-gal. circular concrete reservoir on the top of the ridge. This will give a total head of approximately 180 ft. on the lower portions of the barracks.

For construction purposes there already existed two steel tanks (16,000 and 40,000 gal.) on the hill for the Iowa National Guard encampment, whose grounds are included in the cantonment. Sewers and water mains are being installed at the rate of about 1¼ miles and 0.75 mile per day respectively.

A 30-in. trunk sewer extends 17,000 ft. to the Des Moines River. Treatment of the sewage is considered unnecessary, as no city now uses this river for water supply. The ridge breaks down into rolling country to the south, so that there is little deep cutting. Most of the trenching is good machine work, except for a few hundred feet of quicksand at the lower end. A dragline and at least four different makes of trenchers have been brought in for the sewer and water trenches.

An alternative plan was to carry the sewage across the valley to Beaver Creek. The distance is nearly as great. The stream is nearly dry in summer so that both tanks and beds would have been required to produce an acceptable effluent.

Staff and Organization

The organization at Camp Dodge is headed by Major M. A. Butler, Engineer Officers' Reserve, who is Constructing Quartermaster. He drew on the construction department of the Great Northern Ry. for the following assistants: A. O. Leach, supervising engineer, A. N. Deuell, assistant supervising engineer; also the following division engineers, W. S. Cooper in charge of roads and pavements, William Burns in charge of railway facilities and materials, H. W. Zolper in charge of sewers, and C. M. Ahlberg in charge of buildings. G. M. Garen, the only division engineer from another company, is in charge of water supply. L. P. Wolff is consulting engineer for sewers and water supply, and Robert Wheelwright is the city planner. H. H. Lotter, senior highway engineer, U. S. Department of Agriculture, is supervising the road construction. A regular line officer, Capt. J. C. Kay, U. S. A., is detailed to assist Major Butler in the necessary routine and matters of military nature.

Charles Weitz' Sons, for whom J. F. Gould is superintendent, is the contractor for all work except the roads and pavements, which were let to the Raymond Wright Co. Both of these firms are of Des Moines.

Water-Waste Survey at Memphis

The pitometer survey of the water system at Memphis, Tenn., was completed last year. The annual report of the Water Department shows that 3169 leaks were detected, of which 2779 were property leaks. The others are classified as follows: Fire hydrants, 112; mains, 93; property metered, 65; services, 43; valves, 43; meters and couplings, 26; stop-cocks, 8. Aside from the detection of leaks, the check of the minimum flow of water at night with the pump records was very satisfactory, showing only a slight difference between the two records. The survey work is distributed over the 43 districts comprising the city proper, and the records indicate the districts still showing excessive consumption (either by legitimate consumption or by waste).

Contractors Speed Grain-Elevator Construction Despite Labor and Material Shortage

Plant Layout for New Orleans Structure Makes Great Use of Machinery—Large Storage Facilities Provided To Insure Against Freight Delay

By A. M. CRAIN
Of the firm Janse Bros., Boomer, Crain & Howe, Contractors, New Orleans, La.

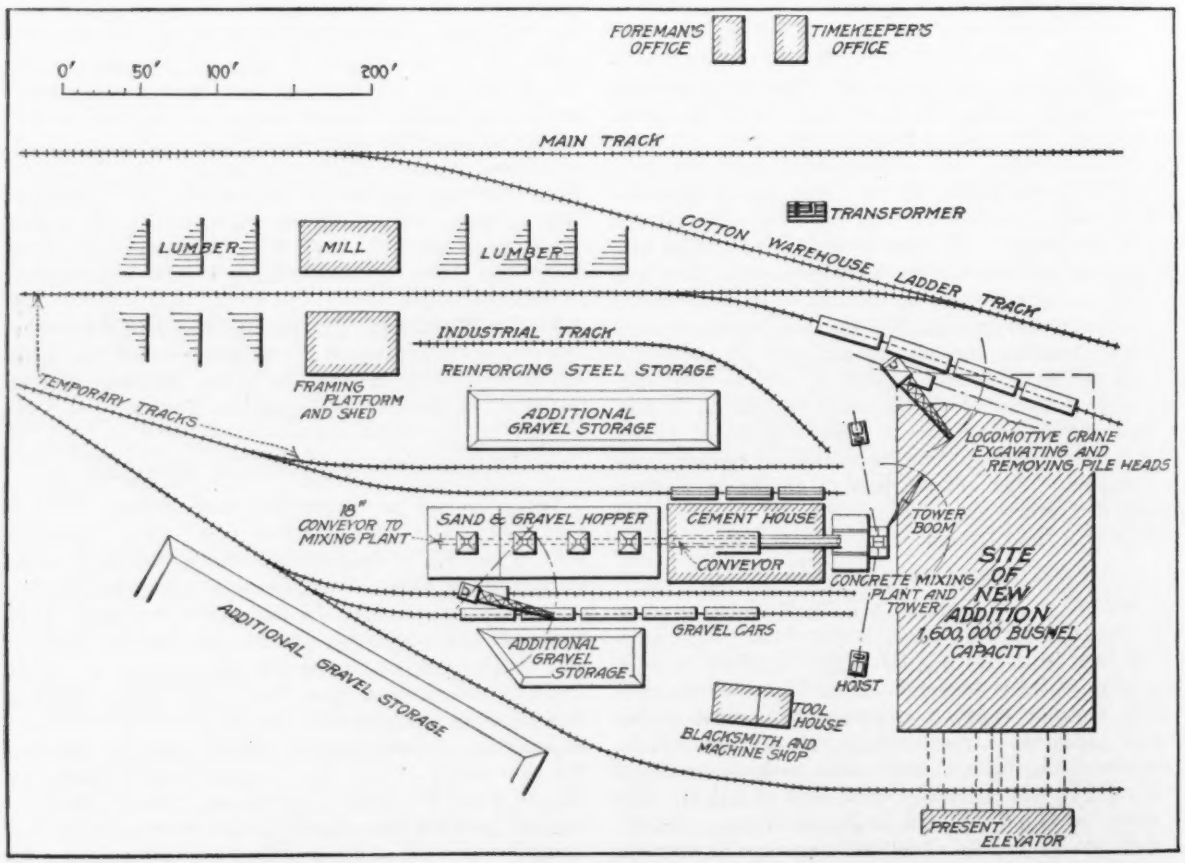
JUST AFTER war was declared, an order was given by the Board of Port Commissioners of New Orleans, La., to start work on a 1,600,000-bushel addition to their public grain elevator. It immediately became apparent to the contractors, Janse Bros., Boomer, Crain & Howe, that they would be called upon to meet very unusual conditions as to car shortage, as well as labor and material shortage. In general, it was foreseen that large quantities of materials would have to be stored, as it would be impossible to regulate the dates of delivery and the quantities delivered. In order to safeguard against a shortage of labor, it was thought advisable to handle the materials as far as possible by mechanical means.

In preparing the contractors' plant layout, an estimate was made of the quantities of materials to be handled, and suitable storage yards, houses, bins, etc., were provided. These buildings, yards and bins were so laid out that they could be served directly by standard-gage tracks, and so that the unloading could all be accomplished by the use of a locomotive crane, the locomotive crane being used to do switching as well as unloading.

Locomotive Crane Works 24 Hours a Day

By studying the accompanying plant layout sketch, it will be seen that the locomotive crane is capable of handling a very large amount of work, making it possible for the contractor to keep it busy 24 hours per day.

Approximately 20,000 cu.yd. of excavation was removed by the crane operating an orange-peel bucket, loading the dirt directly on the flat-cars, which were switched by a switch engine to a dump on the river front. Another locomotive crane, rented temporarily, unloaded the dirt into the river. After the excavation



NEW ORLEANS GRAIN ELEVATOR BUILT BY PLANT WHICH PERMITS GREAT AMOUNT OF STORAGE

LOCOMOTIVE CRANE CONTROLS WHOLE JOB ON GRAIN ELEVATOR AT NEW ORLEANS

was removed, gravel, sand, lumber, steel, etc., began to arrive at the site of the work, so that the crane was kept busy unloading these materials. As the piledriving proceeded, the pile cutoffs were removed from the hole by the locomotive crane and placed in storage piles, from which they were worked up with a portable sawmill and the lumber later used in the construction of formwork.

The sand, gravel and cement are removed from the storage bins by belt conveyors and delivered to the mixing house, which contains a battery of two 1-yd. mixers, the surplus gravel and sand piles being handled into the storage bins by the use of the locomotive crane.

Provision was made for storing approximately 10,000 cu.yd. of sand and gravel and 10,000 bbl. of cement. So much trouble later developed in the way of securing cars for delivery of gravel, sand and cement that it would have been almost impossible to maintain an organization, except at a prohibitive expense. The large storage capacity for materials made it possible for the work to proceed at a uniform speed, which is desirable on construction work.

After fabricating the form units in the sawmill and on the framing platform, the trackage made it very economical to transfer the finished forms directly to the building, the locomotive crane being used to place them in the building. The reinforcing steel, after being bent, was handled in the same manner.

While the plant layout as shown might appear to be expensive, it has been found to be very economical in the long run, when it is considered how much labor at high prices was saved.

First-Class Carpenters Kept on Job

In nearly every part of the construction some accommodation of an unusual condition had to be arranged for. By beginning the formwork at about the time the excavation was half completed, the contractors were able to pick out a gang of about 30 first-class carpenters and keep these men steadily employed throughout the job. To do this, everything was built up in units on a framing platform adjacent to the sawmill. In order to reduce further the cost of the formwork, a very complete woodworking mill was equipped with two swing cutoff saws, one 40-in. band-saw, one power rip-saw, boring machine, grindstone, and emery wheel for gumming circular saws. This mill was operated with a 20-

PORTABLE SAWMILL ON CITY JOB MAKES CONCRETE FORMS FROM PILE CUTOFFS

hp. electric motor and laid out in such a manner that material traveled in straight lines, with a minimum of rehandling from the material piles through the mill and to the framing platform.

It was observed that the carpenters working on the framing platform were almost exhausted before the day's work was completed, owing to the excessive heat and bright sun. A rough roof was put over this platform so that the men could work in comfort, without hats or outer clothing, and the efficiency of the gang was increased almost 50%.

The forms for a grain elevator when made up in units are, of necessity, very heavy and cumbersome. To

LARGE STORAGE CAPACITY PERMITS WORK TO GO ON DESPITE FREIGHT EMBARGOES

handle these economically, they were pushed to one side of the framing platform on trucks and push-cars. Three times a day the locomotive crane spent about an hour taking the finished forms away from the platform and piling them in storage piles along the tracks, where they were again picked up by the crane.

Laborers Come at Sound of Gong

A number of laborers worked around the mill carrying lumber, etc. When the carpenters completed their heavy unit of formwork, a gong was rung, and these laborers immediately came to the framing platform and removed the completed piece of work. The carpenters, in the meantime, started another form, each gang having enough room to carry on two operations. The gong was used so that the foreman in charge did not have to hunt up and call each individual laborer.

Reinforcing steel was piled and blocked up so that all the handling was done by the crane.

The sand and gravel, as well as the cement, were carried to the mixing hoppers on a 20-in. belt conveyor. The gravel and sand conveyor belt discharged into a hopper above the mixing floor. The cement belt ran through the cement shed, directly under the sand and gravel belt, and discharged on the mixing floor of the concrete plant. The plant had a capacity of from 40 to 50 cu.yd. per hour. Two Smith mixers of 1 yd. capacity each mixed the concrete, and two 8 x 12-in. American hoisting engines hoisted the concrete in buckets, which were made in the contractors' shop, up a double tower 160 ft. high. The concrete was spouted to a hopper and placed in its final position by the use of concrete carts. The concrete mixers and conveyor belts were electrically operated.

Several years ago the contractors experienced many minor annoyances from concrete tower equipment built too light to stand the wear and tear of rapid modern construction work. To eliminate this, all sheaves on the concrete tower are of extra size and weight, the sheaves being keyed onto heavy shafts which run in bearings, equipped with large compression grease cups. This equipment is quite costly, but is found to pay for itself by eliminating minor delays from burnt-out bearings and sheaves.

The concrete buckets and receiving hoppers were of ¼ in. boiler plate and heavy angles, the guide angles being 5 x 4 in. The receiving hoppers were similar to the hoisting buckets and supported by cables, and handled in the same manner as the hoisting buckets. This feature is necessary, owing to the fact that points of discharge are constantly changing.

The blacksmith and machine shop was equipped with lathe, power grinders, power drill press, power bolt and threading and cutting machines, punches and shears. The several thousands of bolts required, as well as all gratings and light structural work, were made up in this shop.

That the layout and general methods of construction, as explained on this New Orleans work, fulfilled the purpose for which they were designed, is shown by the fact that construction work proceeded smoothly right through the car shortage and other difficulties. The construction is under the supervision of J. Devereux O'Reilly, chief engineer for the Board of Port Commissioners of New Orleans. The writer is resident partner on the work. E. T. Malloy is general superintendent, and R. R. Hepinstall is chief draftsman.

Collections of Paving Data

The State Bureau of Municipal Information of the New York Conference of Mayors is continuing its good work of collecting data in various municipal fields. Three such collections, in typewritten form, are before us: No. 245, "Street Oiling in New York State Cities in 1916" (5 pp.; 50c.). No. 246, "Experience of American Cities and States in Concrete Paving" (23 pp.; $2.10). No. 255, "Method of Levying Assessments and Awarding Contracts for New Paving in Large Cities" (20 pp.; $1.05). The reports may be obtained for the prices stated from the Public Affairs Information Service, White Plains, New York.

Build Concrete Shell Around Tall Steel Water Tanks

Panel Forms and Staging Held by Bolts and Raised from Floats—Concreting Approximately Continuous—Build Road for Delivery of Materials—Work Done To Improve Real-Estate Values

TO MAINTAIN or increase real-estate values in the vicinity of standpipes, which, considered as rusty steel tanks dominating the surrounding landscape, are usually viewed by property owners as but one degree removed from gasholders, the Cincinnati Water Department now incases them in concrete. In the case of the Eastern Hills tanks, the second group to be so incased, the problem of placing a concrete shell around five 40-ft. diameter steel cylinders 100 ft. high was solved by using combined form panels and staging bolted to the steel and raised a panel at a time by derricks mounted on floats at the top of each corner tank.

The cylinders were erected first and kept full of water during concreting to maintain them as nearly as possible in cylindrical shape and prevent splitting the concrete shell, which might have been strained were the steel incased while in a slightly elliptical form and then forced into a true circle by the water pressure when filled for the first time. With the tank steel in place to the top, it became impossible to use sliding forms, even if the numerous offsets would have permitted it, and hence the floats were employed.

In the preparation of plans for the two most recently constructed tanks for the distribution system of the City of Cincinnati, utility has not been the only consideration. It is considered a crime to erect unsightly, bare steel tanks in a residential district, the increased cost of architectural embellishment and of parking the surrounding grounds being considered as money well spent. The old Mt. Auburn tanks, two 40 x 70-ft. bare steel tanks situated in one of the best residential districts and facing a beautiful park, form an eyesore in the landscape in the opinion of the Water Department, which hopes within the near future to incase these tanks in masonry, improve the grounds and add another beauty spot to the city.

When an effort was made to secure property for the Western Hills tanks, the first to be incased in concrete, much opposition was raised by property owners on the plea that unsightly tanks would depreciate the value of surrounding real estate. For this reason the most desirable site could not be secured, except at a prohibitive price. These tanks, built on an ornamental concrete foundation and surrounded by paneled concrete, present a very pleasing appearance and have been the subject of much praise. Instead of declining, property values in the vicinity have increased. Consequently, when plans were made for the Eastern Hills tanks no trouble was encountered in obtaining the necessary property, a very desirable site being offered, and at a very reasonable price.

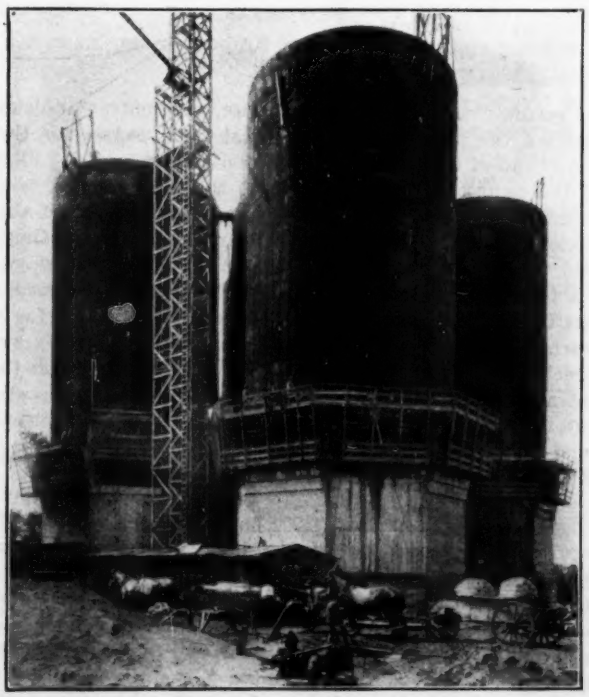
To Resemble Huge Chess Man

The Eastern Hills reservoir consists of a group of five steel stand pipes, 40 ft. in diameter by 100 ft. in height, the four outer tanks spaced at the corners of a 61-ft. square, the fifth being placed in the center.

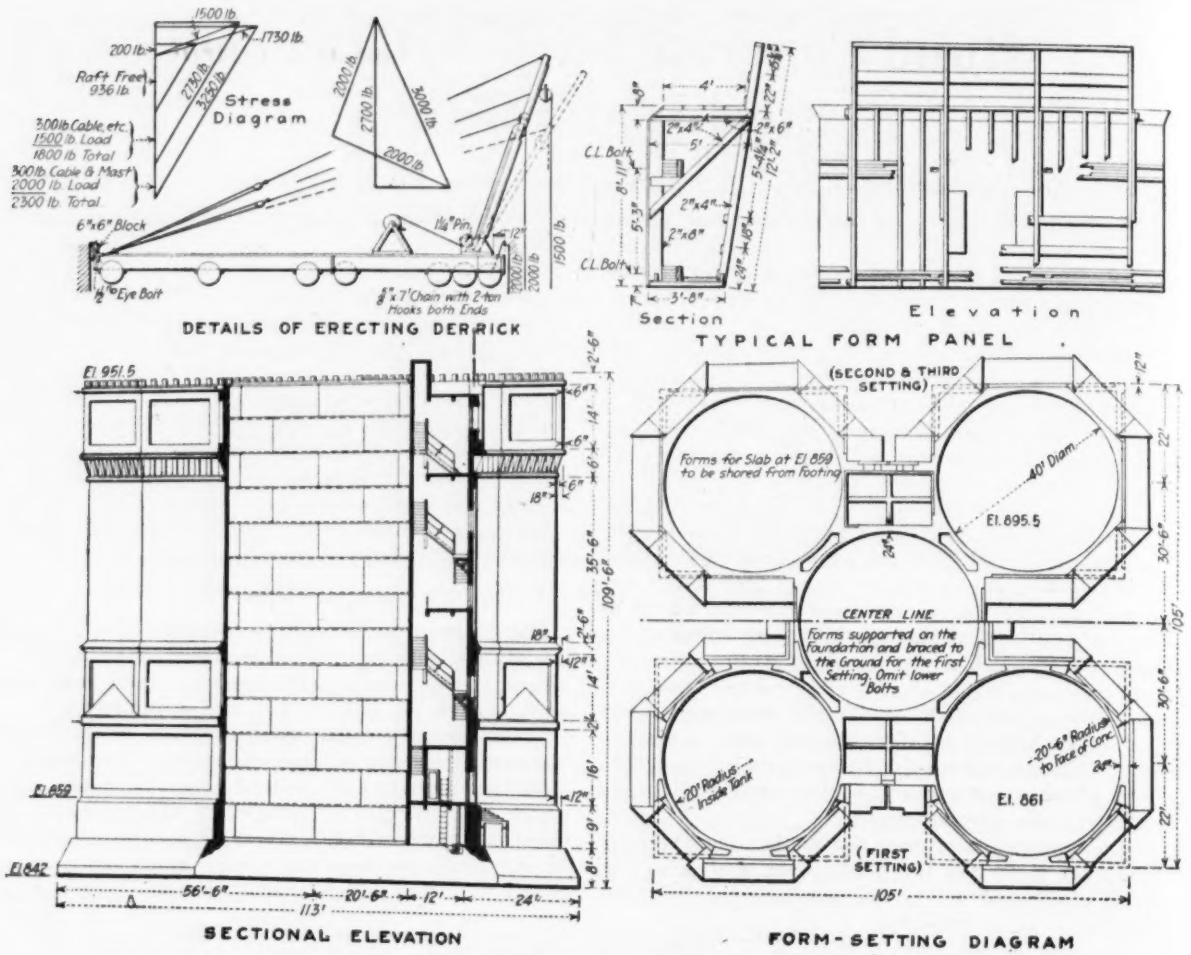
When completed, the Eastern Hills reservoir will somewhat resemble a large chess man. The base for more than a quarter of the total height is square, above which the structure is octagonal. The casing of the center tank of the five, however, is square in plan, and in the recess between the south corner tanks an inclosed stair well with concrete walls and landings and steel stairs is located. The office room for the gages is also located in this space at the foot of the stairs, which lead to an observation platform on top of the tanks. The shell is reinforced vertically and horizontally, chiefly to take up temperature stresses, the steel tanks being designed to withstand all loads. The minimum 6-in. thickness of the shell was determined entirely by the least clearance in which the reinforced concrete could be placed with economy.

The exterior surface of the concrete is to be picked clean, washed with diluted acid and water and receive a dash coat of portland-cement mortar, except the belt courses, corbels and parapets, which are to be rubbed smooth.

It will be evident that the forms used for the con-



FORMS HANDLED BY FLOATS IN CORNER TANKS



ONE SET OF FORM PANELS ADAPTED TO ENTIRE HEIGHT OF ORNAMENTAL CASING FOR STEEL TANKS IN CINCINNATI

crete casing had to meet two peculiar conditions. They must be changed in form during the progress of construction, and must be held and raised by some method with which the presence of the completed shells, filled with water, would not interfere. In designing the tanks, U-shaped pieces of plate, each end of which was riveted to the tank steel, and the outstanding bend of which had a hole in it for a form bolt, were provided for holding the forms to the tanks during concreting. The means of raising the forms, and of altering their shape, were left to the contractor.

Early in April last the contractor set up a 1-yd. mixer and tower in the recess next the stair well and began the construction of forms and floats for raising them. A portable sawmill was used in this work.

Forms Changed from Round to Octagon

At the upper edge the form panels support runways forming a continuous platform around and between the tanks, on which concrete is delivered in carts from the hoisting tower. As will be seen from the drawings, the square base of the structure is not filled solid with concrete, but consists of a thin, nearly circular casing around the tanks, with air spaces between this and the outer wall, 1 ft. thick. Rather than form all this at once, the contractor devised a way of using the octagonal form panels for the nearly circular inner casing by fitting two sets of fillers inside each panel, as shown. At the next setting, when the outer square wall was stepped in, one set of these fillers was removed to give the correct shape to the inner casing. The forms were carried up in this way until the octagon proper was reached, when the second set of filler blocks was removed. The forms for the outer walls were built up from the base at this stage and concreted. When the octagonal forms reach the corbel course they will have to be enlarged and cut down again slightly for the upper portion of the work.

Barrel Floats Raise Panels

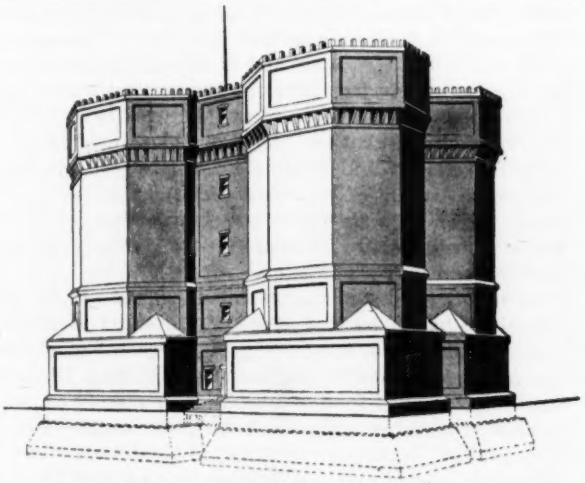
A two-boom, crab-operated rig resting on empty oil barrels on the water surface of each of the four corner tanks raises the forms, a panel at a time. Each panel weighs about a ton, and to pick this weight from a floating platform of reasonable cost which would fit in a 40-ft. circle was found to be out of the question. The rear end of each float is therefore blocked down from the Z-bar which forms the top of each tank and the forward end held by hooks over this Z-bar. In picking a form, the rig is thus independent of its flotation, most

of the load being taken on the hook bars at the boom end, and the buoyancy of the float being used only while rotating the rig from one form to the next.

In raising the form panels, each of which is held by two rows of bolts, the bolts are screwed out of the nuts, which remain embedded beneath the steel clips riveted to the tank plates. The forms are then swung out slightly and raised 5 ft. 3 in., the bolts which came out of the upper ranger being screwed back into the same holes in the concrete, but through the lower ranger. The bolts taken out of the lower ranger are then passed through the upper one and screwed into nuts behind the next row of clips.

Concreting Approximately Continuous

There are 270 to 300 yd. of concrete in a complete lift, which must be distributed over a considerable area, the foundation plan being 100 ft. on a side. It is therefore possible by using stop planks to concrete one-half



TANKS TO BE COVERED WITH IVY TWENTY FEET ABOVE GROUND

of the structure while the horizontal reinforcing is being set and the forms raised on the other half, so that the mixing plant is kept going at the rate of 100 yd. or more a day. The total volume of concrete, exclusive of the footings, which were placed with another plant, is about 3800 yd. The hoisting tower is double, one side being used for the concrete skip and the other containing an elevator for the workmen. The tower also mounts a boom for raising the reinforcing.

The mixer, having a power loader, is supplied by wheeling with materials brought to the site in wagons and motor trucks. The streets on top of the hill being unpaved, and wet weather prevailing when the hauling was begun, the contractor laid a corduroy road of ties, covered with cinders, to the nearest paved highway about 1000 ft. south of the work.

The tanks were designed and are being built under the direction of J. A. Hiller, General Superintendent of the Cincinnati Water-Works. T. J. Mulloy is resident engineer in charge. The Ferro-Concrete Construction Co., of which W. P. Anderson is president, are the contractors. J. Hodges is in charge of the work for the contractors, while the forms and methods of construction were designed by Henry D. Loring, engineer for this firm.

Steel Arch To Replace a Famous Cantilever Bridge

First of Its Type in This Country, the Michigan Central Bridge at Niagara Is Now 34 Years Old and Inadequate

A STEEL arch of about 560-ft. span is to take the place of the Niagara cantilever bridge of the Michigan Central R.R. at Niagara Falls, N. Y. The cantilever bridge is famous as being the first of its type in this country, having been built in 1883-84 to the designs of the late C. C. Schneider. Each of the two cantilevers is 395 ft. long, with 195-ft. anchor arm, 175-ft. river arm and 25-ft. tower span. The suspended span is 120 ft., making a total length of 910 ft. The height is 240 ft. from the water to rail level. The two lines of trusses are 28 ft. c. to c., and the deck carries a double track.

The cantilever bridge was strengthened in 1900 in order to adapt it to the greatly increased loading. This remarkable piece of bridgework consisted in building a third truss on the center line of the structure, supported on new columns in the towers. Further strengthening to meet the requirements of the still heavier loadings of the present day is not practicable, and the famous bridge, which has already given 33 years of active service, is to be replaced by a new bridge of a different type.

The new steel arch bridge will have a clear span of about 560 ft., with a rise of about 132 ft. from the hinges to the bottom chord, while the truss depth at the crown will be about 30 ft. The bridge will carry three tracks. The present steel-arch railway bridge at Niagara Falls, built in 1896-97, has a span of 550 ft., with a rise of 114 ft. from springing line to bottom chord, or 134 ft. to the deck.

No time has been set for the construction of the new bridge. Under present conditions definite action will probably be postponed, but the plans are in preparation. This work is in charge of H. Ibsen, special bridge engineer, who has a separate staff independent of the bridge department. The work is under the direction of J. F. Deimling, acting chief engineer of the Michigan Central R.R. during the absence of George W. Webb (now a colonel in the army).

Wisconsin Architects Must Register

An architect's registration law was passed by the recently adjourned Wisconsin legislature. According to S. T. Williams, state building inspector, it provides that after Jan. 1 no person shall use the title "architect" unless he has a certificate of registration from the examining board. Any other person may, however, design buildings without hindrance as long as he does not use the title "architect." Thus the law follows the lines of the New York law and not those of the Illinois law, which has been the source of so much controversy between the architects and the engineers. The Wisconsin examining board consists of the state architect and the dean of the Engineering College of the state university, exofficio, together with three architects appointed by the Industrial Commission. The appointment is placed with the Industrial Commission because it now administers the state building code.

Changes in Cleveland Sewage-Disposal Plans Recommended

Fine Screens Advised by Fuller After Adverse Report on Tests by Pratt and Gascoigne—Summer Chlorination at Two Plants—Sprinkling Filters and Dortmund Tanks at the Other

MARKED changes in the methods of sewage treatment at Cleveland, Ohio, as proposed by R. Winthrop Pratt, consulting engineer on sewerage improvements, after several years of investigation, were recommended in a recent report by George W. Fuller, consulting engineer, New York City. A notable feature of Mr. Fuller's report is his recommendation of fine screens, notwithstanding an adverse report on fine screens after long, detailed tests by Mr. Pratt and George B. Gascoigne. Mr. Fuller recommended fine screens for all three of the proposed sewage-works at Cleveland, but did not specify the make. In place of Imhoff tanks and sprinkling filters at the Cuyahoga River plant he advises that screens be followed by sprinkling filters and deep Dortmund tanks. The activated-sludge process, which has been extensively studied at Cleveland, is regarded by Mr. Fuller as likely to be required at the two lake-front plants in 5 to 20 years. Meanwhile fine screens, with chlorination during the bathing season, are advised by Mr. Fuller at these two plants, instead of Imhoff tanks and chlorination, recommended by Messrs. Pratt and Gascoigne.

The proposed changes in the plans are now before W. H. Dittoe, chief engineer Ohio Department of Health, who has called into consultation Prof. Earl B. Phelps, Washington, D. C.

Course of Events Sketched

Before taking up the screen tests and the Fuller report in detail, the recent course of events pertaining to sewage treatment at Cleveland may be sketched.

During 1913 and the early part of 1914 an extensive series of sewage-treatment tests was made at Cleveland. (See "Report on Tests at Sewage Testing Station," by Robert Hoffmann, commissioner and chief engineer; R. Winthrop Pratt, consulting sanitary engineer; and Harry B. Hommon, chief chemist and bacteriologist. The report was dated 1914, but not published until 1916.) Several fixed screens and one mechanically operated fine screen were tested. The latter removed from 20 to 25% of the suspended matter in the sewage. Settling tanks removed about 45%. The report recommended that clarification be effected by either tank treatment or fine screens. It was believed that the latter would be cheaper, but a large-scale test of fine screens was considered advisable.

For the two proposed lake-front plants clarification was needed to prevent the fouling of bathing beaches and waters with solids, the bacterial infection of the water and to minimize the color of the lake waters about the outfalls. At the outset, it was thought that all necessary clarification could be effected by either tanks or fine screens. In either case chlorination was counted on for needed disinfection during the bathing season.

It having been decided to test a large-size mechanically operated fine screen, contracts were made in 1915 for supplying and installing a Riensch-Wurl screen, to be operated on test by the city. The first sewage passed through the grit chambers and screen on Nov. 19, 1915, but owing to various delays the test was not concluded until Sept. 10, 1916.

The official report on the tests was transmitted to Robert Hoffmann, commissioner and chief engineer, Department of Public Service, on Jan. 15, 1917, by George B. Gascoigne, sanitary engineer, who had charge of the tests under Mr. Hoffmann and R. Winthrop Pratt, consulting engineer. The letter of transmittal states that the first draft of the report was submitted to Mr. Pratt for criticism and that the report as submitted "contains such corrections and modifications as were mutually deemed advisable." The report declared that the screen failed to comply with the contract provisions as to removal of solid matter from the sewage, volume of sewage and continuity of action.

Before the tests were completed, Messrs. Pratt and Gascoigne had concluded that for Cleveland conditions tank treatment would be far preferable to fine screens and cost less in total annual charges. On Aug. 10, 1916, they recommended for the lake-front plants: (1) Sedimentation in two-story tanks having six months' sludge storage and digestion capacity; (2) disinfection of settled or partly clarified sewage during the bathing season; (3) disposal of sludge within inclosed structures.

George W. Fuller Reports on Best Procedure

On Feb. 17, 1916, about a month after the date of Mr. Gascoigne's report on the screen tests, George W. Fuller, consulting engineer, New York City, was instructed by Alexander Bernstein, director of public service, to report on the best procedure for Cleveland to adopt for the treatment of its sewage. Mr. Fuller's report, dated May 14, 1917, recommends (1) a fine-screen plant at West 58th St., with chlorination during the bathing season; (2) a fine-screen plant with sprinkling filters and with settling tanks for the filtered sewage, at the southerly site, on the Cuyahoga River; and (3) fine screens and chlorination at East 140th St., the site of the testing station.

With this general review of the two reports, each may be taken up in some detail, beginning with that on the screen tests by Mr. Gascoigne.

The screen consisted of a revolving inclined 14-ft. circular disk of perforated brass with the central portion replaced by a truncated one. The perforations were $\frac{1}{32}$ in. wide and 2 in. long, comprising altogether less than 10% of the total area of the disk. The screen was partly submerged in the sewage being screened. As

it rotated, the floating solids were removed, carried upward and swept off by revolving brushes. Before the sewage reached the screen, it passed through coarse bar screens and grit chambers. The bar screens had clear openings of 2 in. during the official test. The grit chambers were of the two-story type, 50 ft. long, designed for a velocity of 1 ft. per sec. and a detention period of 50 seconds.

The screen was operated by the city, with Karl Probeck as resident engineer and chemist in immediate charge, under the general direction of Messrs. Hoffmann and Pratt, already mentioned. George B. Sowers, assistant engineer of sewage disposal, participated in the installation of the screen and in the preparation of the report.

Screen Contract Requirements

The main requirements of the contract were: (1) That the screen should be capable of passing a maximum of 7,500,000 gal. of sewage per 24 hours with a maximum loss of head of 2 ft.; (2) that during a three months' test, by and at the expense of the city, beginning two weeks after the installation of the screen "and operating at least 90% of this period, the screen shall so operate that its efficiency will meet the approval of the Ohio State Board of Health"; that the "intent" of the contract was "results comparable to settling tanks with a flow-through period of 1½ hours," and that "before the approval of the Ohio State Board of Health will be applied for by the city of Cleveland, such results must be approximated."

Payment for the screen was to be 20% on delivery; 75% "at the conclusion of the test if the apparatus has met the requirements" of the contract, and 5% after the customary lapse of one year.

The report states that prospective bidders for a test screen were informed of the results with settling tanks obtained at the testing station. These indicated a 45% removal of suspended solids in a 1½-hour flowing-through period. An early draft of the test requirements provided for a 50% removal of suspended solids, as determined by the Gooch crucible process, over a continuous period of four months. Two screen manufacturers, including the Sanitation Corporation, which controls the Riensch-Wurl screen in this country, objected "to the definite 50% removal," the report states, apparently regarding screens as "competitors of sedimentation tanks" and feeling that a definite 50% removal guarantee might be considered as a precedent to be applied to any sewage elsewhere. The test requirement was therefore fixed as stated, but it was verbally understood, the report says, that the removal to be obtained would be "approximately 45%" and that it would "be determined by the Gooch crucible method."

Reading between the lines of the report, it appears that there was subsequent controversy over the test methods employed. As the report states, the city was made judge of whether the test requirements as to removal of solids was met. We are informed that it never applied to the Ohio State Board of Health for approval of the operating efficiency of the screen and never made the 75% and the 5% payment to the contractor.

Although sewage first passed through the screen on Nov. 19, 1915, the official test did not begin until Mar. 20, 1916. Repeated breakdowns prevented the continuous 90-day test called for by the contract. The official testing finally ran through 175 days, from which 100 days were selected as representing "the best accomplishments" considered in all phases.

Experience showed the importance of supporting the screen so as to keep it in alignment. Otherwise, the seal at the inlet side was broken, the sewage passed under instead of over the screen, and the brushes struck against the sharp edge of the screen and were worn. This seemed to demonstrate the disadvantage of the overhung type of screen.

Various incidents which resulted in shutdowns led to changing the clear openings between the bar screens, ahead of the grit chambers, from 3 in. to 1 in., but the narrower openings cut the fine screenings from 10 to 5 buckets a day, so 2-in. openings were adopted and were used throughout the official test.

The tests indicated the need for a trained mechanic to keep the screen in good adjustment and repair. The safe life of a screen is placed at 10 years in the report.

Keeping Screen Clear Was Finally Simplified

By reversing the brushes and by applying gasoline about three times a week the brushes, which at first became very dirty and greasy, were kept in good operating condition. A combination of tar and oil wastes, wool washings and grease made keeping the screens clean an important phase of the work, but finally this became a comparatively simple operation. It was effected by flushing the screen with cold and then with hot water through a 1-in. perforated pipe placed over and close to the line on the screen just in advance of its immersion in the sewage and along the part of the screen just swept by the brushes. Water under 80 lb. pressure was applied—cold water for 5 and hot water for 2 min. Although this is a simple method of cleaning, it has the disadvantage "that the material removed from the slots gets into the effluent and is costly."

How Nearly Screen Met Sewage Capacity Test

For only one week of the test was the 7,500,000-gal. maximum guaranteed capacity of the screen reached. The average maximum rate was 5,000,000 gal., or only 4,700,000 gal. if allowance be made for the fact that while the screen treated 96% of the night flow it treated only 76% of the stronger day flow—the total volume of sewage being in excess of what the screen could pass, night and day.

The screen was so installed that the maximum loss of head was only 22 in., but it was estimated that even had the full permissible loss of head of 24 in. been attained, the 7,500,000-gal. capacity rate would not have been reached.

The percentage removal of solids computed by three different methods is shown by the accompanying table. On the weighed-screenings basis, the removal of total suspended matter was 4%—which may be corrected to 8% if it be considered that the grit chamber removed 2% that would otherwise be removed by the screen and if another 2% be allowed because the screen did not treat a constant proportion of the flow to the plant. The report states: "It is believed that this figure is the maximum which can be expected as an average accomplishment of the screen when operating over long pe-

riods on the sewage discharged at the West 58th St. site."

By both the suspended-solids and settleable-solids methods, the removal was apparently negative in many instances. After discussing this and related matters and making various corrections, the report concludes that "*under the most favorable condition* [italics ours—Editor], a removal based on settleable solids" might be obtained as high as 19%. One of these corrections

PERCENTAGE REMOVAL OF SOLIDS

Date Week Ended	Weighed Screenings			Suspended Solids			Settleable Solids		
	Day	Nt.	Average*	Day	Nt.	Average*	Day	Nt.	Average*
Mar. 26	5	4	5	—	1	—	—	14	—
Apr. 2	5	5	5	—	8	0	9	0	10
Apr. 9	4	6	5	—	3	—	—	16	—
Apr. 16	4	4	4	0	—	—	15	20	15
May 14	4	2	3	0	9	2	—	12	—
July 2	4	3	4	—	0	—	13	5	11
July 9	4	3	4	10	—	8	2	4	3
July 16	3	2	3	—	—	—	—	—	—
July 23	3	2	3	9	—	7	12	0	11
July 30	4	3	4	10	3	9	8	0	7
Aug. 20	3	2	3						
Aug. 27	3	2	3	5	—	3	0	—	—
Sept. 3	3	3	3	0	3	1	—	—	—
Sept. 10	2	2	2	6	—	5			
Average	4	3	4						
Mar. 26 to Apr. 16	5	5	5						
May 14	4	2	3						
July 2 to July 30	4	3	4						
Aug. 20 to Sept. 10	3	2	3						

* Day and night results weighted according to the total flow through the screen. — Apparent negative removal.

takes into account an 8-hour result that was 83% above the 24-hour average. The 8% removal figure is used as indicating what the screen could do on this sewage, day in and out.

While the specification did not contemplate tests of a sedimentation tank alongside the screen, yet such tests were made. The results are said to corroborate the conclusion from the 1914 testing report that sedimentation for 1½ hours removes 45% of the suspended solids.

Sewage Screenings Were Burned

Although no part of the test, disposal of the sewage screenings was studied. About 1½ tons of wet screenings were burned daily in a Kewanee garbage incinerator, after their water content had been reduced by a centrifuge. Analyses showed that the screenings had a low fertilizing value. The "handling of the screenings was disagreeable at its best," but it is believed that an incinerator giving a higher temperature would reduce some of the objections and that it would be possible so to operate a screening plant as to make it free from odors.

Results of Tanks and Screens Compared

In summing up, the report puts the average removal of suspended solids by screenings at 8% compared with 45% by sedimentation, or 160 lb. compared with 900 lb. of dry material per 1,000,000 gal. of sewage. On this basis the cost per pound of material removed by screening would be 2c. and by sedimentation only 0.4c. Simplicity of operation lies with tanks rather than screens. As regards odors, the two processes are on an equal footing. Disinfection of screened sewage would require 10 p.p.m. of available chlorine, against only 6 p.p.m. for tank effluent. Screened effluent would retain the original sewage color, while tank effluent would be partly clarified.

"The test has shown that the Riensch-Wurl sewage screen, when viewed from a mechanical standpoint, has a number of commendable points, and that at certain locations when treating sewage or industrial wastes of favorable composition, it should be satisfactory. However, the screen contract for the installation at the West 58th St. site introduced conditions which would ordinarily be considered severe for a screen to accomplish.

"The screen failed to comply with those provisions of the contract which pertain to the removal of solid material from the sewage, the screen's capacity and the continuity of operation.

"Also, the test has definitely shown that a sewage treatment plant at the West 58th St. site which depends upon screens for clarification purposes cannot be expected to accomplish a degree of purification equal to that obtained by sedimentation tanks."

Best Sewage-Disposal Procedure for Cleveland

As already stated, George W. Fuller, consulting engineer, New York City, reported, May 14, 1917, to Alexander Bernstein, director of public service, on the "best procedure for Cleveland to adopt for the treatment of the sewage of the city." This necessitated a consideration of the plans already worked out more or less fully for disposal works on the Cuyahoga River (southerly site) and for two works on Lake Erie (easterly and westerly sites). These plans were based on conclusions drawn from a wide range of experiments at the testing station, described in the 1914 report; subsequent experiments with the activated-sludge process; and the screen tests, outlined in the foregoing pages.

The activated-sludge process is mentioned a number of times in Mr. Fuller's report. At one place he speaks "of the probability of its being the method ultimately to be adopted at plants along the lake front." Present conditions do not warrant its immediate adoption, but Mr. Fuller believes that the fine screens which he recommends for installation at each of three plants would prove a useful preliminary to the activated-sludge process, should it be used later on.

Cuyahoga River or Southerly Plant

The Cuyahoga River, with a drainage area of 830 square miles near its entrance to Lake Erie, is described by Mr. Fuller as "one of the most polluted streams in the country," with very little fresh water in dry weather. Consequently, works which will produce a relatively high degree of purification will ultimately be required at the southerly site. At the easterly and westerly lake sites clarification, with disinfection during the bathing season, is all that is required.

Plans for Imhoff tanks and sprinkling filters at the southerly site had been presented to the state Board of Health for approval before Mr. Fuller was called in, and about $125,000 had been spent in grading the site. Two hours of sedimentation was proposed. The sprinkling filters would have treated sewage at the rate of 20,000 people per acre. Mr. Fuller estimates that these works, with a capacity for 170,000 population, would cost $960,000 to build and $83,160 a year for capital charges and operation. The first cost of fine screens and an activated-sludge plant is estimated at $1,124,412 and the net annual capital and operating charges at $105,500, allowing $24,750 for income from the sludge. For an

activated-sludge plant without screens, the figures would be $904,245, first cost, and $87,890, annual charges, allowing $54,000 income from sludge. (All the estimates in Mr. Fuller's report are as of May 1, 1917.)

Fine Screens Before and Tanks After Filters

Passing over the activated-sludge process as not suitable under present conditions, Mr. Fuller states that by using fine screens instead of Imhoff tanks preliminary to sprinkling filters, the amount of sludge available for fertilizing material may be increased and sprinkler-nozzle clogging lessened. "By arranging the sprinkling filters so as to produce a somewhat more efficient oxidation than ordinarily is accomplished in order to remove colloidal matters," Mr. Fuller believes "that a fertilizer product having a value about 58% that obtained with activated sludge can be secured."

The suspended matter unloaded from the sprinkling filters from time to time would be recovered in deep Dortmund tanks, figured to produce sludge of 90% moisture, although it is believed they would produce an 85% sludge. The yield of sludge is estimated at two-thirds of the suspended solids in the raw sewage, or ⅔ ton per 1,000,000 gal. It is estimated that the ammonia in the dry sludge from the proposed tanks would be 3.5% or 38 lb. of organic nitrogen per 1,000,000 gal. of dry-weather sewage, or 1.9 grams per capita, compared with 65 lb. or 3.2 grams from activated sludge. After the first year it is estimated that 4500 tons of dry sludge containing 3.5% of ammonia would be produced from a population of 170,000, contributing 18,700,000 gal. daily of "quite fresh dry-weather sewage," receiving street wash, but little trade waste. The cost estimates are based on the foregoing figures. They show $1,021,142 as the first cost and $78,190 as the annual net capital and operating charges for a plant at the southerly site, after allowing $31,500 as the income from 4500 tons of sludge at $7 per ton. Operating expenses alone are put at $41,400, or only $9900 more than the estimated revenue from the sale of sludge.

It is proposed that of the $80,000 allowed for sludge pressing and drying plant only $25,000, or enough for a single unit, be expended at the start. With Imhoff tanks, 10,000 tons of dried sludge would have to be got rid of yearly by dumping.

Screens and Chlorination Ultimately Required at Two Other Sites

At the two lake sites Mr. Fuller assumes that eventually the activated-sludge process will be required, but not for 5 to 20 years, depending upon local opinion and progress in state and national control of lake sanitation. For the present, the Ohio authorities have indicated that clarification will suffice, accompanied with chlorination during the bathing season. In this opinion Mr. Fuller concurs.

Mr. Fuller's statement of the case for screens rather than Imhoff tanks for clarification is as follows:

"Two means of clarification of this sewage have been considered—namely, fine screens and sedimentation tanks of the Imhoff type. The former have been studied by means of the test device at West 58th St. and the latter at the testing station at East 140th St. Each of these devices is of European origin and each has an accredited standing both in this country and abroad.

"Fine screens with a slot of $\frac{1}{32}$ in. in width have been found at Dresden to remove about 2.5 cu.ft. of screenings per 1000 population daily. Similar results are being obtained at Daytona, Fla., with a screen having a slot $\frac{1}{16}$ in. in width.

"The testing station at West 58th St., Cleveland, showed a removal of only about one-half this amount, apparently due to the solid matters in the sewage being more thoroughly broken up or comminuted by the velocities of flow in the sewers before reaching the screen. Perhaps trade wastes also have a disintegrating effect upon the solid matters suspended in this sewage. However, the screenings will be increased somewhat by the drainage from the stockyards situated in the territory tributary to the Walworth Run diverting sewer.

Extra Clarification by Imhoff Tanks Unnecessary

"With Imhoff tanks, it is possible to make them of such size as to substantially equal the clarification produced by fine screens, or to build them of a size so as to produce a somewhat greater clarification. With neither fine screens or tanks is it possible to convert the sewage to a clear liquid as is proposed for the southerly plant, where very little river water is available for diluting the treated sewage.

"In my opinion, the additional clarification which it is possible to obtain with Imhoff tanks as compared with fine screens is not necessary at the lake-shore plants at Cleveland. The basis for this opinion is to be found in the sufficiency of fine screening to prevent the formation of a mat on the bottom of the lake, particles from which could be lifted by currents and brought ashore to the beaches. Currents on the lake bottom will in my judgment suitably disperse the sewage freed of coarse matters as it leaves the numerous openings of the submerged outlet pipe.

"Trade wastes at the westerly plant show a considerable amount of pickling liquors which should be curtailed so as not to interfere with the chlorination process for sterilization. This means that at the principal industrial establishments delivering pickling liquors into the sewers, storage facilities should be provided so that the wastes will be discharged say late at night so that all iron wastes will reach the plant within an interval of say one hour.

Screens Preferable to Imhoff Tank at This Site

"In my opinion, a screening plant from an engineering viewpoint is much preferable to an Imhoff tank at this site adjacent to the main western boulevard. It will be free of nuisance and should create a much better impression on the community. The screenings can be removed regularly in motor trucks and sent to the garbage plant or they can be incinerated daily at the screen plant. I prefer the former method, although the estimates of cost are based on the latter procedure.

"As to Imhoff tanks, I do not favor at this locality the accumulation of thousands of tons of putrefying solids and even if the tanks were markedly cheaper it is my opinion that it would be a less desirable installation locally than a fine screening plant."

The comparative costs for screens and for Imhoff tanks at the West 58th St. site, each capable of treating 24,000,000 gal. daily of dry-weather sewage and 64,000,000 gal. of storm flow, and with chlorination in both

cases 100 days per year, are as follows: Fine screenings, $318,032 for construction and $58,370 for annual capital charges and operating expenses; Imhoff tanks, $356,327 for construction and $53,720 for all annual charges.

An activated-sludge plant of 24,000,000 gal. dry-weather flow capacity at the West 58th St. site, but with sludge discharged into the lake instead of being recovered for fertilizer base, is estimated to cost $694,000 to build. Interest and depreciation are put at $47,020 a year and operation (four months in the year) at $26,150. This would make total annual charges of $75,170.

Activated-Sludge Process Not Recommended

The activated-sludge process is not recommended for West 58th St., because:

"1. Sufficient funds are not now available.

"2. Sufficient treatment for some time should be afforded by screening, chlorination and dispersion of the sewage into the lake through the new submerged multiple outlet pipe.

"3. Valuable local data on sludge handling at the garbage plant may be expected in the early future.

"4. Storm overflows at various points along the lake shore, due to the size of the marginal intercepting sewers, will always be a factor for perhaps 4% of the time in the aggregate during the bathing period. This lessens the value somewhat of high-grade purification of the sewage going into the lake, and requires special chlorinating devices and special attention to protect bathers following heavy showers, regardless of the high purification that this process involves. However, at some future date the indications are that this process should be considered for the lake-shore sites."

Postpone 284,000,000-Gal. East-Side Plant

The same reasoning as has been presented for the westerly site leads to recommending fine screens and chlorination four months a year at the easterly site, but owing to lack of funds a postponement of the building of this plant is advised. Its estimated cost is $900,000 for construction and $160,000 a year for annual charges.

A new outlet sewer at the easterly site, 78 in. in diameter, with multiple openings a half mile from shore, had been proposed before Mr. Fuller was called. He indorses it. The estimated cost is $175,000. When it has been provided, he recommends the extension of the present 72-in. outlet with a provision of multiple openings. He also advises chlorination plants for emergency use at 4 of the 27 storm overflows on the two lake-shore intercepting sewers. These, he says, should be made as nearly automatic as possible. Their estimated cost is $25,000 for construction and $5000 a year for operation.

Finally, Mr. Fuller recommends the construction of intercepting sewers to deliver sewage to the southerly or Cuyahoga River site. The estimated cost is $500,000. As most of the work will be in tunnel, contracts should be let at once.

Mr. Fulton states that "it would be desirable also to install promptly" chlorinating devices "at E. 140th St. for use following rains—at least on occasions when intestinal diseases are prevalent in the city." No estimates for the cost of this plant are given.

As Water Meters Increase, Water Consumption Falls

Statistics for 68 Cities Having More Than 11,000,000 Population Arranged in Groups Make a Remarkable Showing

By William R. Hill
Consulting Engineer, Albany, N. Y.

AN INCREASE in the number of meters in use always results in a saving of water that would otherwise be allowed to run to waste from defective fixtures, or by letting it run to obtain cooler water in summer, or to prevent it from freezing in the plumbing in the winter, or from other negligent causes. This will be shown by the result of the use of 930,839 meters in 1915 in 68 cities with an aggregate population of 11,275,238.

The great variety of local circumstances and conditions affecting the consumption of water in different cities renders a comparison of the influence of the use of meters on the consumption of water in one city with that in another of but little value. In order to make a reliable comparison of the influence of the use of meters, the 68 cities included in the accompanying table

THE USE OF WATER METERS IN 68 CITIES* OF THE UNITED STATES IN 1915 AND ITS EFFECT UPON WATER CONSUMPTION

Group	No. of Cities	Population per Group	Daily Consumption, Gallons: Total, Millions	Per Capita: Range	Per Capita: Average	No. of Services	No. of Meters	Per Cent. of Services Metered
1	4	379,198	18.60	45 to 55	49	43,502	41,109	94
2	8	1,307,341	85.88	56 to 70	66	193,057	173,410	89
3	8	926,252	71.23	71 to 80	77	149,781	122,165	81
4	13	1,096,729	97.03	81 to 95	88	170,882	128,571	75
5	7	1,083,068	112.33	96 to 110	104	180,039	125,271	69
6	7	1,408,465	159.74	111 to 120	113	238,291	144,497	60
7	8	1,588,716	203.72	121 to 130	128	271,327	64,266	24
8	9	1,491,518	206.49	131 to 150	138	291,517	55,450	19
9	4	1,993,951	351.66	151 to 200	176	432,583	76,100	17
Total,	68	11,275,238	1,306.68	45 to 200	116	1,970,979	930,839	47

* The cities in each of the nine groups are as follows:

Group No. 1: Brockton, Mass.; Fall River, Mass.; Lowell, Mass.; Covington, Ky.

Group No. 2: New Orleans, La.; Providence, R. I.; Hartford, Conn.; St. Paul, Minn.; Lynn, Mass.; Pawtucket, R. I.; Manchester, N. H.; Taunton, Mass.

Group No. 3: Minneapolis, Minn.; Worcester, Mass.; Paterson, N. J.; New Bedford, Mass.; Somerville, Mass.; Terre Haute, Ind.; Lincoln, Neb.; Sioux City, Ia.

Group No. 4: Columbus, Ohio; Memphis, Tenn.; Yonkers, N. Y.; Hoboken, N. J.; Cambridge, Mass.; Norfolk, Va.; Passaic, N. J.; Jacksonville, Fla.; Houston, Tex.; South Bend, Ind.; New Britain, Conn.; Little Rock, Ark.; Topeka, Kan.

Group No. 5: Newark, N. J.; Rochester, N. Y.; Richmond, Va.; Duluth, Minn.; Charleston, S. C.; Springfield, Mass.; Altoona, Penn.

Group No. 6: Boston, Mass.; Atlanta, Ga.; Toledo, Ohio; Omaha, Neb.; Harrisburg, Penn.; Holyoke, Mass.; Allentown, Penn.

Group No. 7: St. Louis, Mo.; Cincinnati, Ohio; Schenectady, N. Y.; Camden, N. J.; Portland, Me.; Reading, Penn.; Canton, Ohio; Binghamton, N. Y.

Group No. 8: Baltimore, Md.; Jersey City, N. J.; Portland, Ore.; Youngstown, Ohio; Peoria, Ill.; Savannah, Ga.; Mobile, Ala.; Lancaster, Penn.; Macon, Ga.

Group No. 9: Philadelphia, Penn.; Kansas City, Mo.; Kansas City, Kan.; Springfield, Ohio.

have been divided into nine groups in accordance with the quantity of water consumed per capita per day. Putting the cities in groups combines all the local circumstances and makes the conditions more general. A comparison of the consumption per capita per day in one group with that of another shows a remarkable uniformity in the decrease of consumption per capita, where the percentage of services metered is increased. The table shows a remarkable uniformity in the decrease in per capita consumption with the increase in the percentage of services metered. Taking the 68 cities as an aggregate, with the great population of 11,275,238, and with 47% of the services metered, the rate

of consumption, 116 gal. per capita per day, agrees very closely with the rate as fixed by dividing the cities into groups.

The rates charged for water in many cities are not equitable, the meter rates being too high. This causes the meter, in many instances, to be very unpopular.

Many medical men have erroneously reported that their use would threaten the health of communities. They do this without being able to refer to any instance on record of such an effect.

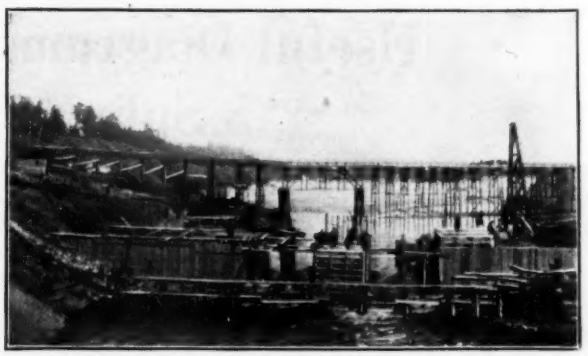
Break in Dam Closed Rapidly at Brainerd, Minn.

Old Dam Across Mississippi Breached February 12 Was Restored and Power Service Was Resumed April 16

ON FEB. 12 part of the old pulp-mill dam near the site of the Northwest Paper Co.'s new plant at Brainerd, Minn., gave away, causing the Mississippi River to make a detour to the west, carrying out more of the old structure and cutting its way through and washing out the westerly bank, 75 ft. high, a distance of 800 feet.

Representatives of George F. Hardy, consulting engineer, New York, the C. L. Pillsbury Co., Minneapolis, and N. F. Helmers, of the contracting firm of Siems, Helmers and Schaffner, St. Paul, at once made tentative plans for a structure to replace the break. The contract was awarded to the latter firm.

Working in the most severe winter weather, with the railways blocked by snowstorms, and in the face of the abnormal car shortage, 8000 yd. of rock and more than 500,000 ft. of timber, 10,000 ft. of piling and 12,000 yd. of earthwork were placed and the full head of 16 ft. developed by Apr. 12. The work was carried on day and night, being illuminated with arc lamps.



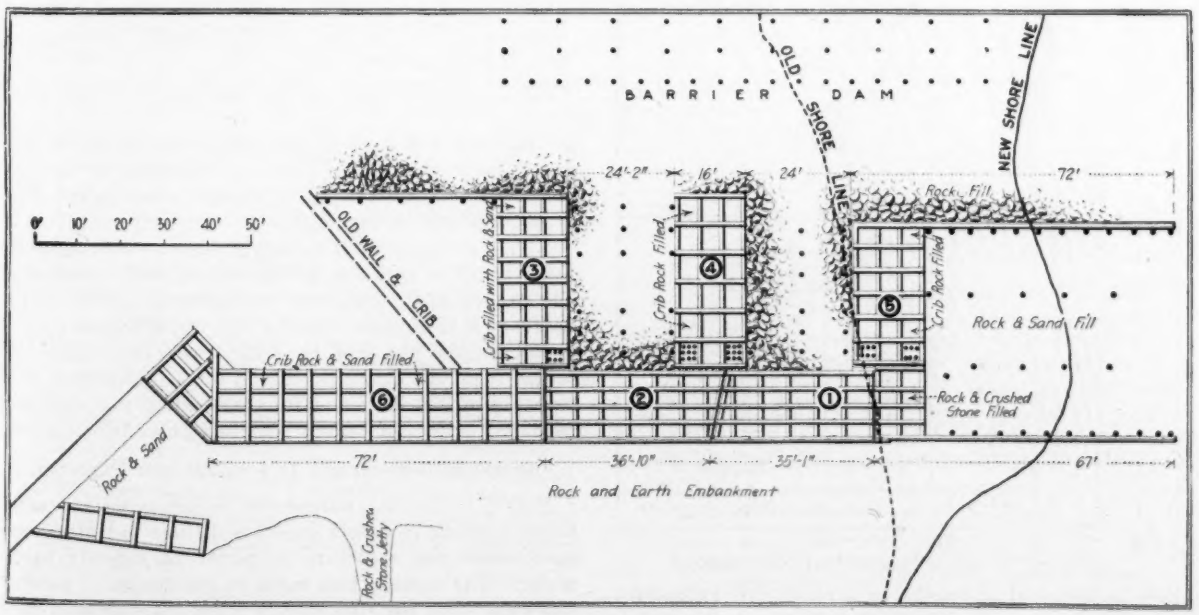
CLOSING THE BREAK IN THE DAM AT BRAINERD, MINN.

Not the least obstacle was the inaccessibility of the work, which necessitated the rebuilding of 100 ft. of trestle highway bridge 60 ft. high, and the reinforcing of 300 ft. more, the placing of two cableways, erection of two piledrivers and laying of a mile of track before work was under way.

A temporary barrier dam was first built out from the shore 110 ft. into the stream, across the washout, to retard the current. It consisted of random piling driven to refusal and filled around with rock. At the same time tons of rock were hauled across the bridge in 1½-yd. cars and deposited in the washout by skidding down the bank or unloaded from the 1-yd. skips of the cableways to pave the bottom of the river. Cribs 3, 4, 5 and 6 were then built and slid into position after cutting the necessary opening in the ice.

The two key cribs for closing the dam were floated into position Apr. 4, and filled with rock.

The work was carried on under the direction of N. F. Helmers, of the contracting company. D. Fairchild superintended the construction. H. Bennett, civil engineer, represented George F. Hardy, of New York, and the paper company's interests.



FIRST A BARRIER DAM WAS BUILT UPSTREAM, THEN CRIBS AND KEY CRIBS WERE BUILT TO CLOSE THE BREAK IN THE DAM

Useful Diagrams for the Design of Subway Sidewalls

Rolled-Steel Beams Required To Satisfy Specifications of City of Philadelphia Easily Selected—Method Eliminates Tedious Calculations for Bending Moments

By HENRY HYMAN
Assistant Engineer, City Transit Department, Philadelphia, Penn.

DIAGRAMS which eliminate the tedious calculation for bending moments and allow rapid selection of standard rolled beams for the sidewalls of subway construction have been developed by the writer in connection with the design of both the New York and the Philadelphia subways. The accompanying figures include such diagrams based upon the specifications of the City Transit Department of Philadelphia, but the explanation and formulas given will enable anyone to construct similar diagrams to suit other requirements. Of course, the bending moments due to other pressures than those used for the diagrams can easily be obtained by ratio.

Typical Construction Assumed

In the construction of subways and other rectangular subsurface structures, the sidewalls are generally built either of reinforced concrete or of rolled or built-up steel columns placed underneath the transverse roof beams. Thus the sidewall must sustain both direct stress due to the roof loads and the bending stress due to side pressure of the earth, or earth and water.

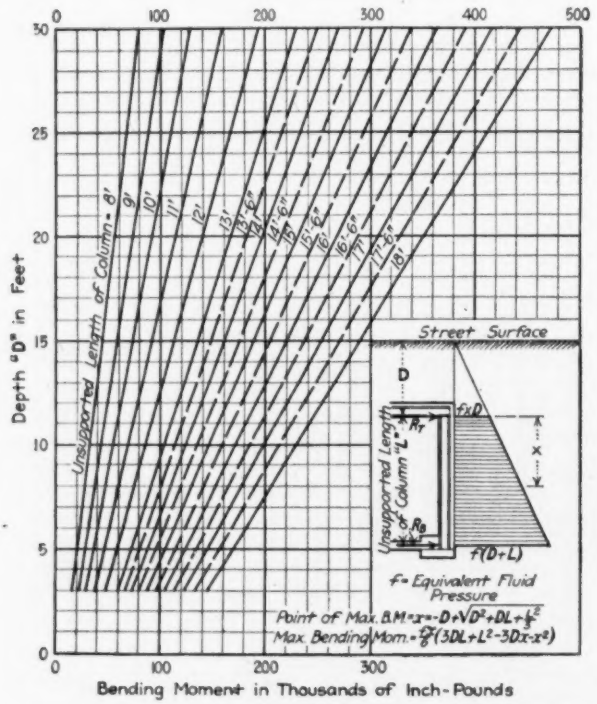


FIG. 1. BENDING MOMENTS DUE TO EARTH PRESSURE
Values are for 1 ft. width of wall and assumed equivalent pressure of 25h lb. per square foot

Almost all of the required calculation can be avoided and great rapidity in designing can be obtained by the use of diagrams.

Fig. 1 is for the purpose of determining the bending moments on sidewalls due to earth pressure. In the design of subway sidewalls it is usual to assume the earth pressure acting as a fluid, adopting some safe value for equivalent fluid pressure. In the design of the New York subways, the Public Service Commission adopted an equivalent fluid pressure of 33h lb.

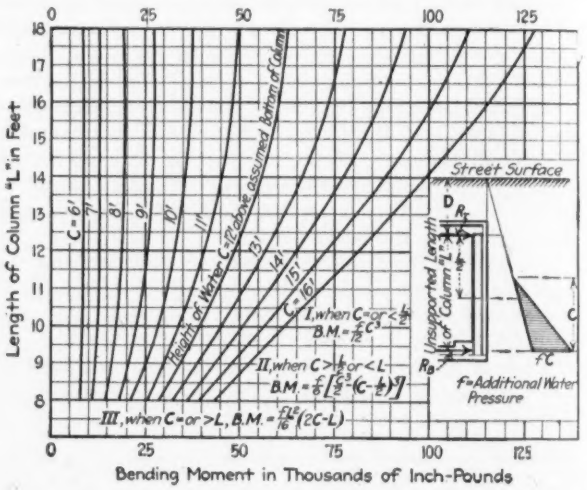


FIG. 2. BENDING MOMENTS DUE TO WATER PRESSURE
Values are for moments at center of column for 1 ft. width of wall and assumed water pressure of 37.5h lb. per square foot

per sq.ft., if h is head in feet, and in designing the proposed subways for the City of Philadelphia, the Department of City Transit is using an equivalent fluid pressure of 25h lb. per sq.ft.

Fig. 1 gives bending moments due to earth pressure for 1 lin.ft. of wall for an equivalent fluid pressure of 25h lb. per sq.ft., and from the formulas given on the diagram it is obvious that for any other pressure f the bending moments will be $f/25$ times the values obtained from the diagram. Thus, for an equivalent fluid pressure of 33h lb. per sq.ft., the bending moments will be 33/25 times the values obtained from the diagram.

Additional Moments Due to Water Pressure

Fig. 2 is for the purpose of determining the additional bending moments on sidewalls due to water pressure, when the structure is partly or entirely below water. The assumptions made in the design of subway sidewalls when the structure is below the waterline vary more widely than the assumptions for earth pressure

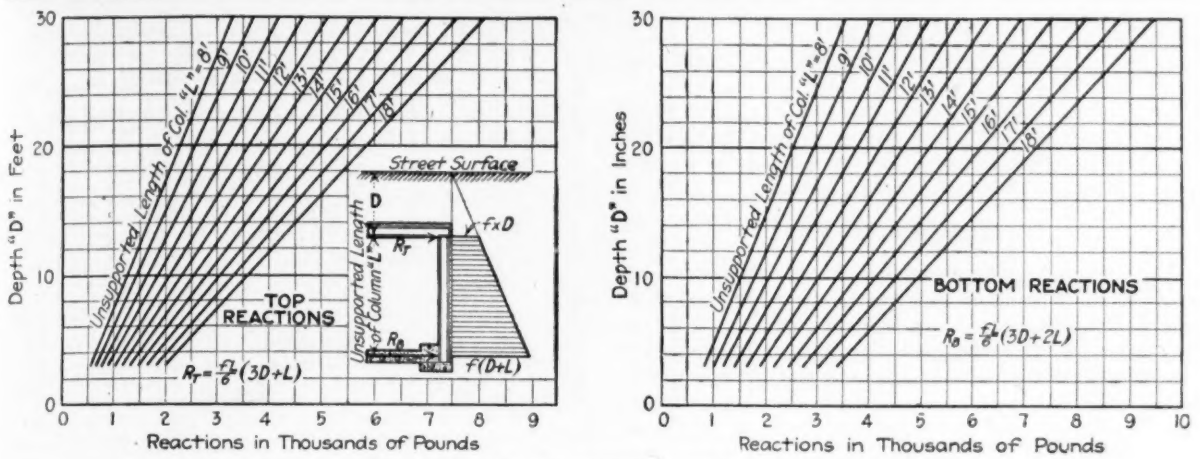


FIG. 3. REACTIONS AT TOP AND BOTTOM DUE TO EARTH PRESSURE
Values are for 1 ft. width of wall and assumed equivalent pressure of 25h lb. per square foot

above the waterline. The practice in New York is to assume in addition to a horizontal pressure of 33h lb. per sq.ft. for earth, a value of 62.5h lb. per sq.ft. for water pressure below the waterline. In Philadelphia the practice is to assume an additional pressure of 37.5h lb. per sq.ft. below water, thus making a total pressure of 62.5h lb. below waterline.

Fig. 2 gives the additional bending moment on 1 lin.ft. of wall for a water pressure of 37.5h lb. per square foot. As in the case of earth pressure, the bending moments due to any other value f will be $f/37.5$ times the values given in the diagram. The values derived from this diagram are of course to be added to the values obtained from Fig. 1 in order to obtain the total bending moments when both earth and water pressure exist.

It is to be noted that the values in this diagram represent not the maximum moments due to water pres-

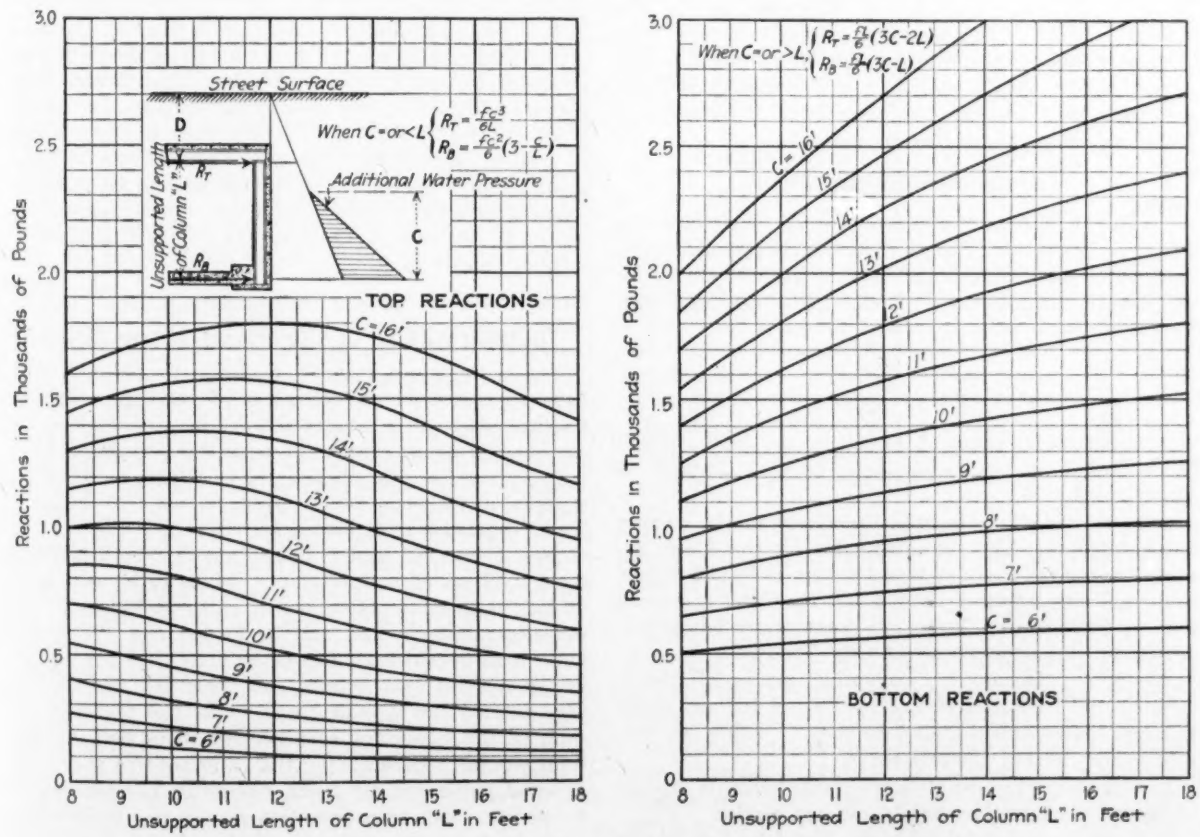


FIG. 4. REACTIONS AT TOP AND BOTTOM DUE TO WATER PRESSURE
Values are for 1 ft. width of wall and assumed water pressure of 37.5h lb. per square foot

sure, but the moments at the center of the columns or sidewall. This is done so that the values will correspond with the values obtained in Fig. 1 (which are the maximum bending moments on the sidewall at a point which is located slightly below the center) so that the two may be added together in order to obtain the total moment due to pressure of both earth and water.

Diagrams for Reactions

Figs. 3 and 4 give the top and bottom reactions on the sidewall for 1 lin.ft. of wall for the same assumed earth and water pressures as are used in Figs. 1 and 2. As in the case of moments, the reactions at both top and bottom of sidewall or columns, for any other assumed values than those used, will vary in direct proportion. These reactions are not generally required in the design of the sidewall columns except when beams with their webs or built-up columns are used.

Fig. 5 gives the required section of standard steel beams for the sidewall, having previously determined from Figs. 1 and 2 the total bending moment, and knowing the direct load on the column under consideration. Values for direct, bending and combined unit stresses must be adopted before such a diagram is constructed.

The usual formula for the design of steel members under a combined direct and bending stress is

$$f = \frac{P}{A} + \frac{Mc}{I}$$

in which f is combined stress in pounds per square inch; P, direct load in pounds; A, area of column section in square inches; M, bending moment in pound-inches (as obtained from Diagrams 1 and 2); c, distance from neutral axis of column to extreme fiber in inches; and I, moment of inertia of column section.

Specified Unit Stresses

The term P/A in the above formula represents the stress in the column due to direct load, and the maximum value allowed for this stress is generally fixed by the column formula used. In the given diagram, Fig. 5, the allowable value for direct stress is

$$\frac{15{,}000}{1 + \frac{l^2}{13{,}500r^2}}$$

with a maximum value of 14,000 lb. per sq.in., which is that used by the Department of City Transit of Philadelphia.

The term Mc/I represents the stress in the column due to bending. The allowable value for this stress assumed for the purpose of this diagram is 20,000 lb. per sq.in. and the allowable value for the total combined stress f is 25,000 lb. per sq.in., these values being permitted by the Department of City Transit.

A similar diagram for any other values of direct, bending and combined fiber stresses and for any other sections than those adopted here can readily be constructed by noting the following:

1. The diagrams are straight lines, hence it is only necessary to figure two points for any section.

2. By assuming some value for direct load it is only necessary to compute from the above formula the bending moment that will bring the stress in the column up to the value adopted for combined unit stress, thus fixing one point on each line. In a similar manner by assuming another value for direct load another point on each line can be plotted.

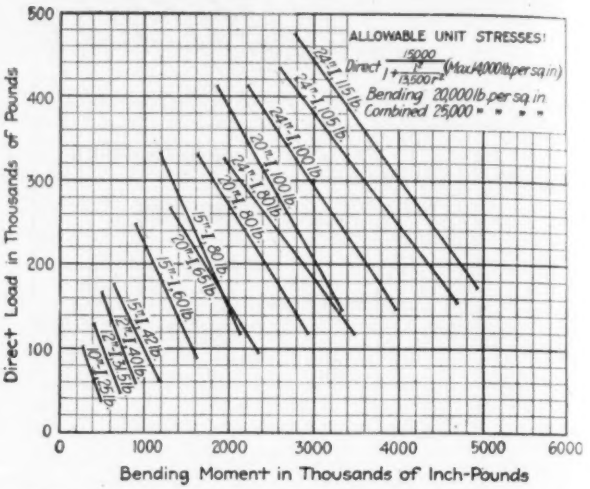


FIG. 5. STANDARD ROLLED BEAMS FOR SIDEWALL COLUMNS

3. The lower limit of each line is fixed by the unit stress that is assumed for bending and should not be extended beyond a bending-moment value equal to this fiber stress multiplied by the section modulus of the section.

4. The upper limit of each line is fixed by the unit stress that is assumed for direct load and should not be extended beyond a direct-load value equal to this fiber stress multiplied by the area of the section.

The values in Figs. 1 to 4 inclusive are for a width of wall equal to 1 ft. The values taken from the diagrams should therefore be multiplied by the distance between columns or bents, to derive the corresponding values to be used in choosing the required section of column from Fig. 5.

Industrial Use of Cleveland-Akron Road

The travel count recently made on the 40-mile road between Cleveland and Akron is of particular interest because the road is constructed for heavy travel and is paved with brick except for a section of about three miles. From 6 p.m. on May 18 to 6 p.m. on May 21, a period of 72 hours, 9804 vehicles passed over the road. These consisted of 11 loaded and 18 empty trucks rated at over 5 tons, 96 loaded and 45 empty trucks rated at 5 tons, 58 loaded and 47 empty trucks rated at 3 tons, 96 loaded and 136 empty trucks rated at 1½ tons, 9106 passenger automobiles, and 50 loaded and 141 empty horse-drawn vehicles. It will be seen that 5% of the motor vehicles were trucks, and the count showed that they carried 890 tons of goods, or 22 full carloads. If each of the passenger cars carried three persons, the total number moved during the 72 hours was about 180 railroad passenger-car loads, assuming 150 passengers to the car. This transportation service was rendered in a district where railway service is now severely strained, and a large industrial population in Akron is dependent on the road for shipping facilities.

Workmen's Compensation on War Construction Heavy Risk

Accidents in Cantonment Work May Run High Unless Care Is Taken—One Contractor Posts "Go Slow" Signs

By Chesla C. Sherlock
Secretary, Iowa Industrial Commission, Des Moines

With 16 national army cantonments to build at an extraordinary rate of speed and with each of the 16 contractors for this work pushing from four to six thousand men at top speed day and night, there is danger that industrial accidents will take heavy toll of the construction forces at a time when such labor is exceedingly scarce. Reliable statistics show that the majority of industrial accidents occur during so-called rush periods, and at least one insurance company of those carrying risks on cantonment work considers the hazard very serious.

Construction Naturally a Dangerous Occupation

Of course, no reliable figures are at hand to show what has occurred under similar circumstances, because such an undertaking was never attempted before. Predictions must be based upon what has happened in normal times, with an additional allowance for the fact that in times of great stress a larger percentage of industrial loss is to be expected. According to a special report of the Department of Labor of the State of New York, 1641 fatal accidents occurred in the construction and building trades of that state during a recent four-year period. This may seem a small fraction of the enormous industrial population of that state; but four times as many people are employed in factories in New York as are employed in the building and construction trades, and during the same period only 1285 fatal accidents occurred to factory workers. This included 204 fatalities resulting from three large factory fires. Similar statistics might be quoted for every state in the Union.

While the conditions which produce accidents are going to be present in nearly equal degree in the 16 different jurisdictions, the amounts that the injured workman will be entitled to recover will by no means be the same in the different cantonment centers. This is due to the difference in the working of the various state statutes. The Federal Government will have nothing whatever to do with reimbursing an injured man who is hurt while working in the cantonments. This is not a Federal question, but one to be determined by the state statute wherever the cantonment camps happen to be located. The Federal Government, while it has passed a compensation act, cannot be held for liability in these cases, for the reason that the employer is not the Federal Government, but the private contractor.

But aside from this point, if any unusual percentage of accidents occur, especially if there are a large number of fatalities, the burden thrown upon the insurance companies is going to be great; and these facts must be taken into consideration by contractors who are to have a part in this great activity.

One insurance adjuster who has considerable foresight said, in explaining the situation to the writer, "If we are to come out even on this proposition, I must exert every effort possible to prevent accidents. I am carrying the risk on the cantonment at ——, and I don't propose to have anyone know that I consider it a ticklish proposition. I have installed two tents at the camp, with five trained physicians in charge and twelve of the best nurses I could find. I have everything in those tents that human foresight could think of to care for those who are going to be injured. I have two ambulances in constant readiness to hurry badly injured workmen to the city hospital. I am going to do everything I can to save life and limb."

At one of the cantonments, the contractor in charge of the work has taken every precaution to prevent this waste. He has signs posted in every nook and corner of the city that is being constructed, which read:

Men Working
PLEASE GO SLOW
and
Help Us
Prevent Accidents

Compensation has been tried in normal times and found to be highly successful. If it is to meet the test in these times of war and world strife, the utmost effort must be exerted by those in authority to prevent carelessness and indifference growing up among workmen. These traits of character are, after all, the prime causes of industrial accidents.

It is necessary, if we are to emerge from this conflict in triumph, that our laboring forces be preserved intact to the last man. America's industrial health is too important to the world to allow a single man to be maimed or to lose his life when it could have been prevented by wise counsel and forethought.

Large Amount of Cracked Gasoline Being Used

Cracked, or synthetic, gasolines are being marketed in enormous quantities largely, if not altogether, in the form of blends with straight refinery and casing-head gasoline, according to a circular of the Bureau of Mines. Cracked gasolines are similar to straight refinery products in most physical and chemical properties, but differ chemically in containing varying percentages of unsaturated and aromatic hydrocarbons. It has been demonstrated that these constituents, if present in moderate proportion, do not decrease the value of a gasoline. Also, competent authorities generally concede that by proper engine equipment and adjustment it is possible to use unsaturated hydrocarbons in practically unlimited proportion, although extensive experimental proof of this does not seem to be available.

Effect of Creosoted Pipe on Drinking Water

Weekly samples of water conveyed through 8000 ft. of creosoted pipe at Wenatchee, Wash., are being analyzed to determine the effect of the creosote on water for drinking purposes and agricultural uses. The tests are being supervised by the Bureau of Industrial Research of the University of Washington, which is headed by Dr. H. K. Benson. A similar experiment was conducted at the university last year. At the end of 26 days no trace of creosote could be found in the water.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

ELEMENTS OF SUCCESS AT NASHVILLE

Civic duties properly performed seem to be the ideal of the Engineering Association of Nashville, according to a letter from Hunter McDonald, president, giving additional data on the society's service to that printed in these columns June 28, p. 662. A list of the committees almost leads one to question whether the society is not an association of commerce: National water law, state topographic survey, smoke abatement, buildings and insurance, streets and highways, changes in city charter, uniform boiler law, city planning and nitrate plant.

Paragraphs from Mr. McDonald's letter indicate the trend of activities:

"Our present association since its organization, the beginning of this year, has been quite active in public

THE MIXER
INGREDIENTS:
1 PART OF THE CEMENT OF FELLOWSHIP
3 PARTS OF THE FINE AGGREGATE OF SERVICE
6 PARTS OF THE COARSE AGGREGATE OF PROFESSIONAL PRIDE
AND THE PROPER AMOUNT OF THE PURE WATER OF CHARACTER
THE DENSITY OF THOROUGHNESS
THE REINFORCEMENT OF TENACITY
THE STRENGTH OF PURPOSE
THE FINISH OF SKILL
THE FORM OF ACHIEVEMENT
SPOTTING ALLOWED ONLY UNDER STRICT INSPECTION
OPERATED WITH D.C. ENERGY AS NEEDED BY
THE ENGINEERING ASSOCIATION OF NASHVILLE-TENN.
Stucture No 1
January 5, 1917
Batch No 4

SOCIETY NOTICES HAVE MUCH TO DO WITH ATTENDANCE

affairs, making studies of state and local conditions and making recommendations as to wholesome laws and policies. We have not attempted to go into details, but have pointed out in general where advantageous changes and consequent economies might be effected. We have coöperated with state legislative committees in framing highway bills and the standard boiler-code law, and with the Nashville Commercial Club in framing desirable amendments to our city charter. We have succeeded in writing on our municipal statute books, by cooperation with the City Commission, a building code modeled after that of the National Board of Fire Underwriters, and requiring the enforcement of the American Society of Mechanical Engineers' boiler code within the city limits, and have brought about the extension of our sewer system so as to reach all districts.

"Our organization is recognized as an adjunct of the Commercial Club, although entirely independent of it in our support and opinions. We are called upon for representation on all joint civic movements.

"Looking backward it is difficult to see wherein our course could have been modified to advantage. Our successes have been due to constant watchfulness and personal and disinterested effort. Our failures have been due to the activities of self-seeking politicians who do not wish to have their 'special preserves' encroached upon.

"We have not yet devised a way to get proper publicity in our activities. Our local papers are willing to give their space to anything which lends itself to their particular lines of endeavor, but if it happens to differ with their views in any way, instead of getting their support we are suppressed.

"We have not attempted to bring about the appointment or election of individuals to public places. When called upon by the city authorities to recommend men we have done so with satisfaction to all concerned. Our attitude on this question has been to educate public sentiment up to the necessity of having public work executed in accordance with sound engineering principles. We have not advocated the elevation of engineers to any position, but we feel that when public sentiment appreciates the value of their services it will not be necessary to urge their appointment. We seek to retain public confidence by well-considered action, free from interested motives.

"We have not taken up the employment question in a business-like way, but we have done a good deal of quiet work in this connection with some satisfaction."

ENGINEERS SHOULD GIVE MORE ATTENTION TO PUBLIC ACTIVITIES

The engineer, and especially the young engineer, must give greater attention to public affairs, political activities, etc., and not confine himself to his professional activities. This was one of the strong points made in an address to the American Association of Engineers, at Chicago, on July 27, by William H. Finley, chief engineer of the Chicago & Northwestern Ry., and one of the new vice presidents of the association. Such a step is important in the interest of the engineering profession as well as in that of the individual engineer. The latter not only broadens his view of men and life, but helps to give publicity to his profession and to educate the business community and the public as to the true functions of engineering and the engineer. To quote Mr. Finley:

"The engineers must step into public activities before the technical men can attain the standing and recognition by the general public which other professions have. Above all, they must learn to advertise their work, and not publicly criticize the mistakes of their fellow engineers."

STATE CAPITAL CLUB FINDS LIMITATIONS

Among other community activities the Springfield (Ill.) Engineers' Club keeps its members informed regarding engineering features of public projects and has used the newspapers to explain its stand upon such projects where engineering features are involved. The result is that the engineer's viewpoint has been respected more than if no notice had been taken.

Looking backward, J. R. Hughes, the secretary, states that the club might have been more active in placing its members on public committees appointed by the Commercial Association to make a study of certain projects involving extensive engineering features investigated during the year. Intelligent interest, he adds, brought to the club any measure of success achieved. The club is not satisfied, however, that it gets enough publicity for engineering activities.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Faulty Joint Construction Causes Failure of Monolithic Brick Pavement

Sir—Several interesting failures, due to expansion, have recently occurred in the new monolithic brick pavement the construction of which was fully described in an article appearing in *Engineering News-Record*, Apr. 19, 1917, p. 130.

Following a cool spell of weather, a warm wave swept over the Puget Sound country and reached its maximum on June 13, 1917, when the Weather Bureau at Seattle, eight miles distant, recorded a temperature of 84°. Quite possibly it was a few degrees warmer at the location of the road, but no records are available.

Upon the afternoon of this day, evidence of failure in the road first became apparent. The majority of breaks have occurred in a stretch of the road built during the warm weather of 1916. Here, five breaks appeared at intervals of about 500 ft. Two other breaks in different sections of the road have developed since that date.

The following description of a typical break applies to all the cases observed thus far. The first evidence is the appearance of a very flat arch, noticeable by the raising of the brick above the line of the curb and becoming apparent to those crossing in automobiles. In one instance, when the crown of the arch had risen 2½ in. above the curb level, the span, as indicated by sounding of the surface, was 20 ft.

The passing of automobiles caused a vibration perceptible to one standing upon the brick, through the sense of touch rather than by any visible sign. As the pressure increased, the arch raised itself higher until the point of rupture was reached, when the break occurred with a loud report. This usually happened with the passing of some particularly heavy truck, or an automobile running at high speed. All the courses of bricks were then found to be separated from each other and from the base, as indicated in the accompanying photograph, which was taken after a failure, when a couple of courses had been removed and the rest separated to allow traffic to proceed pending repairs.

Upon removal of the loosened brick the sand-cement cushion was found to be adhering to the base, and its upper surface showed clear impressions of the bottoms of the bricks, with low ridges from ⅛ to ¼ in. in height, indicating the flow upward of the cushion between bricks under the weight of the roller. The bricks were usually unbroken, only about 50 new ones being needed to replace those which were ruptured in each broken area.

Each break occurred at a "cold joint" in the base, at the end of a day's run of concrete. It is interesting to mention that, when ending the day's run, it was the practice on this work *to feather or taper* the end of the base for a distance of a foot or more, instead of leaving the end vertical. Upon resuming the work, the feathered end of the base was well cleaned, painted with cement grout and concreting commenced at once.

When all the loosened bricks were removed from a break, the center line of the cleared area, usually about 10 ft. in width measured along the road, was found to be 2 ft. in advance of the center line of the joint in the base, apparently indicating that the base had ruptured along the plane of the joint above described and the newer part had slid upward above the old portion, thus raising the brick surface along this line and allowing the buckling to begin.

In repairing the breaks, provision was made in each instance for a bituminous expansion joint in the base and, to avoid holding up traffic for any length of time,

PAVING BRICK SEPARATED FROM CONCRETE BASE BY LAPPED JOINTS MOVING

pitch filler was used in all the joints of the brick when relaid, in place of the usual grout filling.

From the foregoing, it would seem that there is no such thing as "monolithic brick pavement" in the strict sense of the term, that the tapered form of joint used to finish off the day's run of concrete base may prove to be a destructive factor under compressive stresses due to temperature changes, and that brick laid without expansion joints is subject to the same laws as long columns unprovided with bracing. It would also appear that the base in this form of pavement is more susceptible to temperature changes than the type where the brick is laid upon a sand or cement-sand cushion.

All county work is under the direction of Samuel J. Humes, county engineer; C. E. Morford, principal assistant, who is directly in charge of construction, furnished the data for this description.

CHARLES P. MOWRY,
Office Deputy, King County Engineer.

Seattle, Wash.

[Proof of the above letter was submitted to W. C. Perkins, chief engineer of the Dunn Wire-Cut-Lug Brick Co., an authority on monolithic brick paving, for comment on King County's experience. Mr. Perkins' explanation follows.—Editor.]

Sir—It is rather difficult to give a correct explanation of any phenomenon of failure of construction in any pavement unless one can make a personal examination of the pavement; but reading the foregoing letter leads me to believe that the breaking of the pavement was mainly due to the method of making the joints in the concrete base at the end of the day's run. The tapered

joint allowed the concrete to slide or slip under thermal stresses and caused a breaking of the wearing surface.

A considerable mileage of monolithic roadways using wirecut lug brick has been constructed during the past two years and no trouble from heaving has occurred to my knowledge; we advocate the making of a vertical joint in the concrete base at the end of the day's work, and do not think it necessary, in fact we believe it a weakness, to use any expansion joint (transversely) in the base.

In reading the description of the building of the road under discussion (*Engineering News-Record*, Apr. 19, 1917), I note that in certain sections the bricks were laid flat and in other sections brick with sides V-scored were used. Under these circumstances, I cannot see how a true monolithic pavement could be obtained, for one of the essentials of a true monolithic pavement is the strong bonding together of the individual bricks, and this is obtainable only when there is a well-defined lug which automatically separates or spaces the bricks, allowing a free flow of the cement grout to the bottom of the brick.

Examinations of pavements where the bricks are laid flat, or where bar lugs were used instead of contact lugs, invariably show lack of penetration of the cement grout filler, and thus a weakening of the brick wearing surface results.

A brick road will not buckle if monolithic; that is to say, if all its parts are equally strong to resist thermal stress. The base will take care of its own strain and the brick wearing surface likewise if the individual units are well bonded together.

WM. C. PERKINS,
Chief Engineer Dunn Wire-Cut-Lug Brick Co.
Conneaut, Ohio.

Water-Hammer Formulas

Sir—The importance of water hammer in pipe lines for hydraulic developments is so great that it is surprising to find the great difference of opinion and general uncertainty of engineers in regard to this subject. A good example of this is the article by Barton M. Jones on p. 794 of *Engineering Record* for Dec. 30, 1916, and the comments on it by R. L. Hearn in the issue of Mar. 31, 1917. These gentlemen offer formulas which may differ from each other by over 500%.

All authorities have agreed on the formula for maximum water hammer:

$$h = \frac{a\,V}{g} \qquad (A)$$

where h is the rise of pressure in feet of water, caused by the sudden complete stopping of the water in the pipe, which is flowing at a velocity of V feet per second, and the velocity of a wave of pressure along the pipe is

$$a = \sqrt{\frac{g}{W\left(\frac{1}{K} + \frac{D}{Et}\right)}} \qquad (B)$$

where

g = Acceleration of gravity;
W = Weight of a unit volume of water;
K = Modulus of elasticity of water in compression;
D = Diameter of pipe;
t = Thickness of pipe walls;
E = Modulus of elasticity of pipe walls in tension.

All of the above must be measured in the same units; for convenience, take pounds, feet and seconds.

This maximum water hammer can only occur when the gate is closed in a time less or equal to $\frac{2L}{a}$, the time necessary for a pressure wave to travel the length of the pipe (L feet) and back to the gate. It is impossible for the water hammer to exceed this amount, as all the energy in the moving column has been expended when this pressure is reached. Any further rise would therefore violate the law of the conservation of energy (dead ends, etc., are not considered).

These facts have not only been proved theoretically many times, but have been checked by the extensive and most careful experiments of J. Joukovsky in Moscow, in 1897.

Inserting the values of K and E suggested by Mr. Jones, formula (B) becomes

$$a = \frac{47{,}200}{\sqrt{\frac{D}{t} + 102}} \qquad (C)$$

Two things have contributed to increase the confusion of engineers on the subject of water hammer: First, mistakes in copying standard formulas; second, using water-hammer formulas for cases for which the men who derived them never intended them.

An example of the first type is Mr. Jones' mistake in formula (C), which was noted in the *Engineering Record* for Jan. 13, 1917. A similar mistake occurs in one of the standard books on hydraulics, which gives D in feet and t in inches, rendering the formula useless. As no derivation for the formulas is given it is impossible to check them, and these mistakes, even though due to typographical errors or mistakes in copying, are just as serious for the engineers using the formulas as errors in theory.

An error of the second sort is the formula of Allievi, given by Mr. Hearn as applicable to all times of gate closing greater than $\frac{2L}{a}$, although Allievi never intended it to be used unless the time of gate closing was considerably greater than $\frac{2L}{a}$. This is apparent to any engineer who has taken the trouble to look up its derivation and may also be seen by inspection, as the formula contains no terms for E, t, K or d, and therefore manifestly cannot take account of the waves traveling along the penstock, which may have an important effect in ordinary closing of gates by a governor in 2 or 3 seconds.

A numerical example shows up the ridiculous results which may be obtained by using this formula. Allievi's formula is

$$h = \frac{NH}{2} + H\sqrt{\frac{N^2}{4} + N} \qquad (D)$$

where

$$N = \left(\frac{LV}{gTH}\right)^2$$

and

H = Static head in feet;
T = Time of closing gate in seconds.

Other symbols as noted above.

Take a penstock 10 ft. in diameter, ½ in. thick, 2000 ft. long, with water flowing at 6 ft. per sec. under a static head of 20 ft. at the gate. The velocity a computed by formula (B) or (C) is 2550 ft. per sec.; $\frac{2L}{a}$ is 1.57 sec. The maximum water hammer possible is, by formula (A), 475 feet.

Suppose the gate is closed in a time greater than $\frac{2L}{a}$, say 1.7 sec. We know that the water hammer will be almost 475 ft., but not quite as high as this figure. Using Allievi's formula (D) with $T = 1.7$, we get $h = 2440$ ft., which is impossible, and more than 500% too high.

Allievi's formula, however, may be accurate for very slow closing of gates, where the effect of the waves traveling up and down the pipe is negligible. But for such a case the simpler formula $h = \frac{LV}{gT}$ is usually sufficiently accurate.

Mr. Jones' formula for water hammer,

$$h = \frac{268{,}800\ Q}{144\ d^2 \sqrt{\frac{D}{t} + 102}} \qquad (E)$$

(D and t are here measured in feet) for times of closing equal to or less than $\frac{2L}{a}$ is identical with formula (A), $h = \frac{aV}{g}$. For slower closing it becomes

$$h = \frac{2\,LV}{g\,T} \qquad (F)$$

This formula is given by Joukovsky and by Mansfield Merriman, who says it is not applicable to all cases. It is correct only for times of gate closing close to $\frac{2L}{a}$, and for slow gate closing may be 100% in error. Although incorrect for slow closing, it is preferable to Allievi's formula, for it always gives results on the safe side, and is never more than 100% off. Allievi's formula, however, may give results for h varying from 60% to 500% of the true values.

The only general formula that the writer has seen which can be used for any time of closing equal to or greater than $\frac{2L}{a}$, is

$$h = \frac{L\,V}{g\left(T - \frac{L}{a}\right)} \qquad (G)$$

This becomes $h = \frac{aV}{g}$ for $T = \frac{2L}{a}$, and for the numerical case above gives 406 ft. rise. The writer derived this formula by simple methods, which are published along with a translation of Allievi's paper in the *Transactions* of the American Society of Civil Engineers, Vol. LXXIX, 1915, p. 238.

As Mr. Jones says, many pipé lines are designed without figuring the water hammer and with no intelligent attempt at putting the metal where it will do the most good. The writer would add that where the water hammer is figured it is generally figured wrong.

MINTON M. WARREN,
Hydraulic Division, Stone & Webster.
Boston.

New Ideas on Water Hammer

Sir—It ought to be of interest to many of your readers to convince themselves that Allievi's formula for the transmission-velocity of the pressure-change, which has been made use of in recent articles, such as for instance in *Engineering Record*, Dec. 30, 1916, and Jan. 13, 1917, has not been proved, and that, as a matter of fact, it cannot be proved and that consequently all further investigations based on said velocity-formula need correction.

The mistake happened as follows: Allievi puts

$$\frac{dc}{dt} - c\frac{dc}{dx} = g\frac{dy}{dx}$$

$$\frac{dc}{dx} = \frac{g}{a^2}\frac{dy}{dt}$$

He then considers the velocity c of the water to be negligible when compared with the transmission velocity a. He neglects $c\frac{dc}{dx}$ in the first equation, but omits to neglect $\frac{dc}{dx}$, which is c times smaller, in the second equation, which should read

$$0 = \frac{g}{a^2}\frac{dy}{dt}. \qquad (1)$$

The value a developed without regard to the velocity of the flow may be all right for such manifestations of sound as may accompany pressure-changes; however, as regards the transmission velocity of pressure-change itself, neither the velocity of the water nor the elastic qualities of water and pipe-metal can be neglected. A certain sudden pressure-change in the last lineal foot of pipe may be caused either by a sudden total shutdown while the normal water-velocity is very small, or by a sudden partial shutdown while the normal water-velocity is very much greater. In both cases appears the same increase of volume, say for instance 0.001 cu.ft. per lin.ft., from compression of the water column and the expansion of the pipe wall. This difference of volume must be filled up by the approaching water before the pressure-change can be transmitted to the foot length next beyond. If the pipe delivers 1 cu.ft. per sec., the transmission can therefore take place 10 times faster than in case only 0.1 cu.ft. per sec. were coming on. Therefore, the transmission velocity of a sudden pressure-change is: In the first case, $1 \div 0.001 = 1000$ ft.; in the second case, however, $0.1 \div 0.001 = 100$ ft.

Evidently Allievi's formula, which gives very little change for the transmission-velocity, requires correction.

CHARLES R. STEINER.
Ruhbank, Zofingen, Switzerland.

Sanitary Engineers in Civil Life Cannot Be Used

Colonel Reynolds, states the *Official Bulletin*, in charge of the newly created Medical Division of Sanitary Inspection, War Department, has received offers of assistance from a number of sanitary engineers in civil life. The work of the division, however, is entirely within the scope of the army, and at present it will be impossible to make use of men outside the service. The division will have charge of all sanitary matters pertaining to service in the field, such as kitchens, mess shelters, ice boxes and all sanitary appurtenances.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Valuable Contribution to Rate Making

REVIEWED BY LEONARD METCALF

Of Metcalf & Eddy, Civil Engineers, Boston and Chicago

PUBLIC UTILITY RATES: A Discussion of the Principles and Practice Underlying Charges for Water, Gas, Electricity, Communication and Transportation Services—By Harry Barker, B.S., M. Am. Inst. E. E.; Associate Editor of "Engineering News-Record." New York: McGraw-Hill Book Co. London: Hill Publishing Co. Cloth; 6 x 9 in.; pp. xiv + 387. $4 net.

After eight years of collection, comparative analysis and study the author has brought to fruition his effort to present "a comprehensive discussion of (1) such corporation and municipal activities as affect service and rates, (2) the trend of public opinion and court and commission decisions, and (3) the most important engineering and economic problems involved. This he has done "in the hope" that the mere presentation, in one volume, of the diverse phases of rate making may be of service in provoking thought—"in spite of the inherent shortcomings of the text."

In its good style and thoroughly readable quality, the book reflects the author's experience as an editor of one of the most successful technical weeklies (*Engineering News*). Though it treats a highly technical subject, it does so in a manner to command the interest of the reader, introducing him with a brief and pertinent historic sketch to a logical presentation of the subject, adding breadth and perspective by a discriminating analysis of the essential differences in the rate-making problem of different utilities. Its chief value lies in the comparison of the differences in the nature and past solutions of the problem.

The subject of rate making is, and must always be, one for specialists, who have been through the mill of experience in building and operating public utilities and who have had, also, an instinctive interest in economic doctrines and their practical working out, under natural conditions and those of more or less arbitrary or legal restraint. Therefore, inasmuch as no man can hope to cover adequately all, or even several, of these highly specialized fields—of railroad, gas, or other utility rate making—a critical analysis of the underlying principles or past acts, which have governed or led up to existing rate schedules, has suggestive value to the expert, as well as interest to the student and general reader.

DEVELOPMENT OF REGULATION SLATED

Chapter I opens with a brief statement of the development of utility regulation. The second chapter draws a proper distinction—though sometimes elusive under actual conditions of service—between "product" and "service" companies and gives some definitions of rates and service. The third and fourth chapters discuss various rate bases, defining the equitable rate as "one by which the legitimate expenses, and reasonable profits, are fairly distributed upon the total service or product given," and illustrate methods of cost segregation.

Then follows an excellent résumé of the evaluation of property. In this, greater stress might have been given to the necessity of permitting a return sufficient to common capital. With the appreciation in property values which has taken place in the past two decades, or longer, stability of investment has increased and capital has been available even under declining nominal rates of return. Had property values been decreasing, however, existing rates of return would have proved inadequate.

Valuation as an engineering task, and the appraisal of land and water rights, are next taken up. The discussion of "cost of appraisal" is likely to prove very misleading, if applied to such highly individualized utilities as water-works, in which topography and natural conditions so largely modify the cost of the property and work involved in its evaluation. Some of the special problems and fallacies encountered are clearly and fairly set forth. The desirability of amortizing intangible and semi-intangible values is interestingly treated, though the difference between what has been and might have been, is not kept before the reader as clearly as desirable. Then follows sound discussion upon reasonable return, interest, compensation for risk and attention, and extra profits.

Chapter VIII, on depreciation, is clear and well expressed, sound and tolerant. Somewhat greater importance might well have been given to the dictates of experience and effect of normal operating conditions, in determining proper depreciation allowance requirements in an old stabilized plant, such as a water-works.

MUTUAL OBLIGATIONS OF PUBLIC AND CORPORATIONS

The mutual obligations of the public and its servant, the public-utility corporation, are well discussed in Chapter IX, on "Miscellaneous Problems Indirectly Related to Rate Making." The author's anxiety over the "vicious cost spiral, . . . the high cost of living . . . " might be calmed by a consideration of the consistent and progressive advance in costs, certainly from earliest biblical times to date.

The chapter on railway rates is perhaps the most absorbing chapter of the book. A reading of it suggests the almost hopeless complexity of competitive, in contradistinction to monopolistic, utility rate regulation and gives evidence of the past influence of the selfish human side of the problem.

Chapter XI sketches the growth in the express business at the expense of the railways and public, and the readjustment, reduction and simplification of the rate schedule on the block system, by the Interstate Commerce Commission, in 1913, with some increases two or three years later.

After an instructive outline of the growth and peculiarities of the street- and interurban-railway transportation business, and the difficulty of equitable comparison of revenue and statistics of one plant with those of another, methods of fixing fares are discussed. These include the Interstate Commerce Commission and American Electric Railway Association apportionment of

standard account items into fixed and movement costs; the Wisconsin Railroad Commission zone system; and the Cleveland experiment. The effect of peak loads, reasonable length of trips and the transfer problem are intelligently discussed. The treatment of the depreciation and retirance problem, as applied to this class of public utilities, is noteworthy.

The classification of water-works with utilities of the "product," rather than the "service" type, is more fancied than real, under operating conditions. In discussing water consumption, reference might well have been made to water-consumption gagings—such as those contained in a report of a special committee of the New England Water-Works Association (see *Jour.* N. E. W.-W. Assoc., Mar. 12, 1913, pp. 29-43)—rather than to sewage-flow gagings. In the discussion of fire protection reference should have been made to the admirable and pioneer effort of the Underwriters to determine a scientific basis for fire-hazard rating contained in "Standard Schedule for Grading Cities and Towns of the United States with Reference to Their Fire Defenses and Physical Conditions," prepared by the National Board of Fire Underwriters, New York City, and adopted by them Dec. 14, 1916.

The persistence of the uniform rate schedule in the gas field and the drift toward a juster recognition of classes of use are clearly set forth, with some references to the Louisville and new Baltimore schedules.

In the electric field the difficulty of fair comparison is clearly shown, in view of the tremendous variation in character and extent of local demand. Resident, Norwich, telephone, Wisconsin, Detroit, Canadian and the Rapp tariff systems are touched upon.

The last chapter, "Telephone Rate Making," is particularly suggestive in view of the character of the service and the length of public control, which have shown "the value of conservative capitalization combined with liberal provision for maintenance, development and retirance." Experience in this field is particularly worthy of study, as "The Bell system, while a natural monopoly, is unique among utilities in that the early conceptions of the organizers of the business seem to have been broad enough so that the same concern, or group of concerns, has accommodated the growth of succeeding years while keeping their procedures always economically sound enough to weather strange and unforeseen business conditions," and this growth has been enormous.

The book is a valuable contribution to the subject of rate making. It should be read by all interested in this field of work—the engineer, the operator, the legislator and the public-service commissioner. It should be particularly helpful to the young student.

Clearing and Grubbing

HANDBOOK OF CLEARING AND GRUBBING METHODS AND COST—By Halbert Powers Gillette, M. Am. Soc. C. E. New York: Clark Book Co., Inc. Leather; 5 x 8 in.; pp. 241; illustrated. $2.50 net.

This book is a collection of previously published information on the subject of clearing and grubbing for farms, railroad construction, reservoir sites and other purposes. Machines, tools and the uses of dynamite are described. Much cost information, which the author admits is not as full as he himself would like, is included. Some of the quotations and costs date well back into the last century. But then, the subject is one which has never inspired an extensive literature.

The English in which the book is written is regrettably careless. What is the good of preaching about the value of proper technical English when authors like Mr. Gillette continue to flood the profession with works in which adjectives are used promiscuously where adverbs are required? And why adorn a book with many such literary gems as the following? "It is true that many smaller roots can be torn up and rooted out by using a rooter plow that is manufactured by the different plow companies. . . . ."

A New Book on Hydro-Electric Practice

REVIEWED BY LEWIS F. MOODY

Consulting Engineer, I. P. Morris Department of William Cramp & Sons Ship and Engine Building Co., Philadelphia, Penn.

AMERICAN HYDRO-ELECTRIC PRACTICE: A Compilation of Useful Data and Information on the Design, Construction and Operation of Hydro-Electric Systems from the Penstocks to Distribution Lines—By Capt. William T. Taylor, Equipment Officer, Royal Flying Corps, England, M. Am. Soc. M. E., etc., and Daniel H. Braymen, M. Am. Inst. E. E., Engineering Editor of "Electrical World." New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 439; many illustrations. $5 net.

Progress in hydraulic power engineering in this country in the last few years has outdistanced all the textbooks, and probably only those engineers active in this field appreciate the inadequate character of the available treatises on the subject. A new book on American hydro-electric practice will therefore be examined with interest by many engineers. The purpose of this review is to consider particularly the portions of the book which are devoted to hydraulic matters.

More than one-half of the volume is taken up with electrical subjects. The hydraulic material is given in the first two chapters and in a few tables and diagrams. This hydraulic material, as stated in the preface, has been largely supplied by Mr. Taylor. Besides reviewing this portion in a general way, the writer will take the opportunity to call attention to some of the serious errors noticed, in the effort to warn against mistakes which might result from them.

The work carries the subtitle, "A compilation of useful data and information on the design, construction and operation of hydro-electric systems from the penstocks to distribution lines," which well describes its scope. A considerable portion of the contents consists of articles which have appeared in technical journals, particularly descriptions of hydro-electric plants. The bringing together of this information is a useful feature. The book, however, suffers from the limitations of the second-hand nature of its contents and from its general plan. It is stated in the preface that "No attempt has been made to make this work a textbook on design in the sense that it should give the fundamentals on which the design and construction of parts of a hydro-electric system are based. It is, on the other hand, a compilation of the practical and essential features of design, construction and operation as worked out in many plants and systems, interpreted and arranged for convenient use and reference by plant designers, constructors and operating engineers."

The first chapter is entitled "General Survey of Water-Power Engineering." The first portion of the chapter gives a good discussion in condensed form of the determination of the available run-off; calculations of storage; and use of hydrographs, including an explana-

tion of the use of the mass diagram or "flow-summation curve," as it is called by the author. Losses in head in penstocks are briefly discussed, and the writer notices with approval the introduction of exponential formulas at this point.

The determination of the economical diameter of pipe lines is treated in a way which is suitable for water-supply systems and pipes for steady flow, but which is not adequate for turbine penstocks and pipe lines subject to surges and pressure variations. The statement that "the fixing of the diameter is subject to very close calculations" by methods which ignore the pressure variations and their effect on turbine regulation is not correct as a general proposition, and is inconsistent with the later statement that the "control of the water is a serious problem."

The subdivision on the "Effective Head of a Development" would be excellent if it were not stated that the friction head to be deducted from the gross head in determining the effective head on the turbine should include the "passages leading to and away from the wheel." The draft tube should be regarded as an integral part of the turbine, and the losses within it should be charged against the turbine.

Dangers of Second-Hand Information

Some of the dangers inherent in reworking second-hand information are instanced in the latter part of this chapter. The subdivision headed "Characteristics of Water Wheels" and those following have apparently been abstracted from sources not mentioned, one of which can be identified as a paper presented by H. Birchard Taylor before the Canadian Society of Civil Engineers, Jan. 15, 1914. Unfortunately, the references have not been quoted intact, and serious errors have been introduced by alterations or omissions. Thus, under the heading "Effective Draft Tubes for Water Wheels," which is probably intended to read "*Effect of* Draft Tubes. . ." the dangerously misleading statement occurs: "The placing of a wheel within the natural limit (34 ft.) from the elevation of tailrace-water is no indication of the proper elevation, because it is necessary to allow at least 3 to 4 ft. margin between the total draft-head and a perfect vacuum to prevent the breaking of the water column in the draft tube due to inertia effects of sudden changes of load such as those mentioned above." In this and the preceding sentences the important item of velocity head is entirely omitted, thus leaving a matter which is frequently misunderstood by engineers not directly engaged in waterwheel work in such shape that serious errors are likely to be committed by anyone accepting the implied statement that a wheel may be safely located 30 or 31 ft. above tailwater. The writer therefore wishes to clear up this matter, which can be done by quoting Mr. Taylor's paper more fully, as follows: "It is evident that should the total draft head, or the sum of the static draft head and the velocity head at the runner discharge, exceed the height of the water barometer, the continuity of flow of the water on leaving the runner is destroyed—therefore, the placing of a turbine simply within 34 ft. from the elevation of tailwater is no indication that the elevation has been properly chosen; for aside from the limitations outlined above, it is also necessary to allow at least 3 or 4 ft. margin between the total draft head and a perfect vacuum to prevent the breaking of the column of water in the draft tube due to inertia effects resulting from sudden changes of load on the turbines."

In the succeeding subdivision, headed "Speed Regulation of Water Wheels," there has evidently been an omission, causing the second paragraph to describe the operation of relief valves while ostensibly referring to governors, the subject of relief valves not having been mentioned.

Other difficulties arising from the use of borrowed material are noticeable. The statement that "*During the past two years* [italics mine] efficiencies of 89 to 92% have become quite common, while a maximum value of 93.7% has been secured" is surprising, until it is realized that this was taken from Mr. Taylor's paper, written over three years ago.

A lack of knowledge of the engineering principles underlying hydraulic turbine work seems to be indicated by several passages, such as the poor attempt to explain the specific-speed relation and its use, a subject which should be understood by anyone handling hydro-electric problems. There is confusion in the statement of the specific-speed formula, because the system of units is indicated in a misleading way. The only attempt to explain or derive the formula is in the following sentence: "The value $h^{\frac{1}{2}}$ as a factor for specific speed, N_s is from the assumption that two wheels of similar design and horsepower capacity will have varying speeds on different heads, as

$$h^{\frac{1}{2}} = h^{\frac{1}{2}} \times (h^{\frac{1}{2}})^{\frac{1}{2}} = h \times h^{\frac{1}{2}}."$$

The only reference to the theory of turbines and their operation is contained in the following two sentences: "It can be easily shown that the waterwheel horsepower varies as $h^{\frac{1}{2}}$ which is fundamental. Equally so is the formula [*sic*] $v = c\sqrt{2gh}$, one of the most important of hydraulic formulas as it enters into all calculations and designs of waterwheels." These bits of information will be enjoyed by hydraulic engineers.

Charts and Diagrams Mislead

The chapter contains a number of charts and diagrams, some of which the writer has endeavored to check with the following results: According to one diagram a 10,000-kw. single-runner turbine under 300 ft. head should operate at 130 r.p.m., while actually a speed of 360 r.p.m. would be adopted for such conditions. According to another chart, a 10,000-kw. runner under the same head of 300 ft. would operate at 2400 r.p.m. whereas actually a speed of 1200 r.p.m. or less would be used. From another chart a 5-ft. diameter penstock under a pressure head of 50 ft. would be made of $\frac{1}{16}$-in. steel.

The second chapter contains some useful abstracts of articles from the technical journals, describing various stations. A number of these descriptions could easily have been made of greater value by including some recent articles, bringing the descriptions more nearly up to date.

Other errors and misconceptions have been noted, but these need not be further enumerated, as it has been made reasonably clear that much reliance should not be placed on the material in the book without independently checking its accuracy.

Pioneer Work on Wharves and Piers

WHARVES AND PIERS: Their Design, Construction and Equipment—By Carleton Greene, A. B., C. E., M. Am. Soc. C. E. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 248; 155 illustrations. $3 net.

In no branch of engineering have there been so many strides forward in the past decade as in the design and construction of wharves and piers for harbors. It was not so long ago that only one or two types were available for this kind of work. For permanent construction a fill was placed between stone retaining walls; for less permanent work, a wooden pile and timber wharf was built. With the advent of concrete and reinforced-concrete the variations in design multiplied almost beyond number, so that today the pier designer has at his command a great number of different variations, many of which will solve the same problem.

In spite of this great advance, or perhaps because of it, the literature on the subject is most meager. Practically everything that can be found on recent wharf and pier construction must be sought in the files of technical magazines and society publications. Mr. Greene has, therefore, done a considerable service for the profession in collecting the many types which appear in his new book. The book is frankly a catalog of standard designs. There appears little attempt to expand theory, but as a catalog, using that word in its best sense, there is little to be wished for.

The main section is devoted to the structure of the piers and wharves themselves. The following and less exhaustive part takes up the design of sheds for wharves and piers and a final and still less ambitious section is devoted to cargo-handling machinery. Finally, a number of detail costs afford some general information on that important subject.

Harriman and the Colorado River Break

THE SALTON SEA: An Account of Harriman's Fight with the Colorado River—By George Kennan. Cloth; 6 x 9 in.; pp. 106; illustrated. $1.

In the whole history of engineering struggles against the forces of nature the long hard fight to control the break in the Colorado River and save the Imperial Valley and its irrigation system from destruction stands unrivalled. The story has been outlined again and again and has been told in great technical detail. In the present volume it is briefly but amply detailed in a popular way by a master writer from the viewpoint of the great railroad financier and developer who provided the capital and the will power that enabled a notable group of engineers to turn the mighty floods of the Colorado back from their mad rush to the Salton Sea.

The author prepares for his main story by sketching the geologic and written history of the Salton Sink and surrounding lands far below sea level in what was once the upper part of the Gulf of California. The conversion of the desert into an oasis by irrigation is pictured. Then come the stories of "The Runaway River," the many failures and final engineering triumph in closing the break, and finally an account of the almost imperative order of ex-President Roosevelt to Harriman to close the breach and the failure of the attempts to get Congress to foot the bills incurred by the Southern Pacific in so doing.

The author draws freely and with full credit upon various sources of technical information, including H. T. Cory's paper (Trans. Am. Soc. C. E.) on "The Imperial Valley and the Salton Sink." Of course the whole story, coming from Mr. Kennan, is well told.

Street Work in Ontario Cities

REPORT ON STREET IMPROVEMENT IN ONTARIO—Toronto, Ont.: W. A. McLean, Deputy Minister of Highways. Paper; 6 x 10 in.; pp. 200; illustrated.

After some 20 pages on street planning and street improvements in general, this useful and interesting report presents "the progress of street improvement" in 21 cities and 11 towns of the Province of Ontario. Most of the municipalities included "were visited, the streets inspected, photographs taken and data concerning the improvement of the streets obtained." The data were collected and compiled by R. C. Muir and edited by G. Cameron Parker, of the Ontario Highway Department staff.

The general plan followed for each city is first to present an historical sketch of street improvements. Then the organization of the local street department is given and the methods of carrying on the work are described, including the equipment used. Types of pavements being laid are described, with extracts from specifications. There are also descriptions of notable street-improvement jobs. Curbs and sidewalks are taken up and methods of assessments outlined. Line drawings and photographs add to the value and interest of the report, which is a most creditable production.

Textbook of Topographical Drawing

TOPOGRAPHICAL DRAWING—By Edwin R. Stuart, Professor of Drawing, United States Military Academy. New York: McGraw-Hill Book Co., Inc. Paper; 6 x 9 in.; pp. 119.

Designed "as a basis for a course of instruction and practice in topographical drawing," and written by a master in the art, this volume should make a broad appeal to instructors, students and draftsmen. After referring to the pioneer "standard conventional signs for the use of all map-making departments of the Government" adopted in 1912 by the United States Geographic Board (War Dept. Doc. No. 418, United States Geological Survey, Washington, D. C.) the author states that the present book attempts to "point the way to a satisfactory standard of practice"—which was left untouched in the pamphlet mentioned. After chapters on maps, instruments, methods, etc., designed for reading and reference, the author presents the practice of topographical drawing, lettering, conventional signs (four chapters) and map drawing. The presentation is simple, clear and practical.

Manufacture of Portland Cement

THE PORTLAND CEMENT INDUSTRY: A Practical Treatise on the Building, Equipping and Economical Running of a Portland Cement Plant, with Notes on Physical Testing—By William Alden Brown, Assoc. Am. Soc. C. E., Member South Wales Institute of Engineers; formerly Works Manager, Aberthaw and Bristol Channel Portland Cement Co., South Wales. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 168; 35 plates and numerous text illustrations. $3 net.

The author of this book has had some experience in American portland cement mills and more recently in the English trade. In a prefatory paragraph he makes clear that he considers the American methods of manufacture of portland cement superior in many ways to those used in Great Britain or in Germany and makes a plea to the British industry to modernize its methods or else lose the markets of the world.

The book itself is a very good categorical description of the manufacture of portland cement, with special detailed reference to the individual parts making up the cement mill. More attention is paid to the factory itself and to raw materials than to chemical investigations, although there are six chapters on the technique of testing.

Public Health and Sanitation

SANITATION PRACTICALLY APPLIED—By Harold Bacon Wood, M. D., Dr. P. H., Assistant Commissioner, West Virginia State Department of Health; formerly Director Mississippi State Board of Health Laboratory, Whole-Time Health Officer, Rochester, Minn., and Topeka, Kan. Cloth; 6 x 8 in.; pp. 473; illustrated. $3 net.

The fundamental principles, and to a considerable degree the practice as well, of public health and sanitation are here presented in a sane and readable way. The book, says the author, "is intended primarily for the health officer and for the student of public health topics, but the employer, the employee, the teacher, the man in his own home or office or the municipal official may get some practical directions from it."

Broadly speaking, the book follows the general lines of the more recent and shorter public health manuals, with the omission of such matters as health board organization, laboratory methods and some of the more strictly medical aspects of public health. Statistics, the control of communicable diseases, child welfare, school hygiene, pure foods, clean milk, water-supplies, sewage disposal (with a few paragraphs on garbage and refuse), hygiene of the home and factory, the destruction of disease-bearing insects and health educational work are considered in succession.

The chapter on water-supplies includes a confusing discussion on whether a city should build water-works or sewers first. Under sewage disposal there are a number of statements which are likely to mislead the uninformed—a class for whom it may be assumed that the book is designed. A little revision here and there would clarify and correct these questionable passages in the new edition which a book so good in the main deserves at an early date.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

COMMERCE AND NAVIGATION OF THE UNITED STATES, 1916—Washington, D. C.: Bureau of Foreign and Domestic Commerce. Cloth; 9 x 12 in.; pp. 950. $1.50 from Superintendent of Documents.

COMMISSION ON BUILDING DISTRICTS AND RESTRICTIONS: Final Report, June 2, 1916—New York City: Board of Estimate and Apportionment. Cloth; 7 x 10 in.; pp. 299; illustrated.

MANITOBA HYDROMETRIC SURVEY FOR 1915—Ottawa, Ont.: Dominion Water-Power Branch. Paper; 6 x 9 in.; pp. 278; illustrated.

MOTOR GASOLINE: Properties, Laboratory Methods of Testing, and Practical Specifications—By E. W. Dean. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 27; folding plate. 5 cents from Superintendent of Documents.

THE COUNTY: The Dark Continent of American Politics—By H. S. Gilbertson, New York: The National Short Ballot Association. Cloth; 6 x 8 in.; pp. 297. $2.

Designed to throw light on a hitherto neglected unit of government. The short ballot, county home rule, and the county manager plan are the chief reforms suggested. There is a brief chapter designed to show some of the inefficiency and corruption connected with the administration of roads and bridges by counties.

THE ELEMENTS OF HYDROLOGY—By Adolph F. Meyer, M. Am. Soc. C. E., Consulting Engineer, Associate Professor of Hydraulic Engineering, University of Minnesota. New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 487; 287 illustrations, including some on folding plates. $4 net.

HANDBOOK OF SHIP CALCULATIONS, CONSTRUCTION AND OPERATION: A Book of Reference for Shipowners, Ship Officers, Ship and Engine Draftsmen, Marine Engineers, and Others Engaged in the Building and Operating of Ships. By Charles H. Hughes, Naval Architect and Engineer. New York: D. Appleton & Co. Flexible leather; 5 x 7 in.; pp. 739; illustrated. $5.

HIGHWAY IMPROVEMENT IN OREGON: Papers presented at a Conference for furthering the adoption of a Highway Code for Oregon held at Portland, Jan. 3 and 4, 1917: October, 1916, and January, 1917, numbers of "The Commonwealth Review." Eugene, Ore.: University of Oregon. Paper; 7 x 10 in.; pp. 482.

HOME SANITATION: The Improved Closet, the Small Sewer System, Sewage Disposal, the Protection and Improvement of Sanitary Conditions in the Home—By V. M. Ehlers, State Sanitary Engineer. Austin, Tex.: State Board of Health. Paper; 6 x 9 in.; pp. 34; illustrated.

INTERNATIONAL CABLE REGISTER OF THE WORLD: In Conjunction with Western Union Telegraphic Code. New York and London: International Cable Directory Co. Cloth; 8 x 10 in.; pp. 1242. $8 in conjunction with code.

Classified directory by cities, industries, materials, professions, etc., with alphabetical index of all registered telegraphic addresses—as "First Bank, Pocatello."

A MAJOR STREET PLAN FOR ST. LOUIS—By City Plan Commission of St. Louis, Mo., Harland Bartholomew, Engineer. Paper; 6 x 9 in.; pp. 86; illustrated.

A summary of this report appeared in "Engineering News-Record," July 19, 1917.

MASSACHUSETTS COMMISSION ON WATERWAYS AND PUBLIC LANDS, 1916.—Boston: The Commission. Cloth; 6 x 9 in.; pp. 167.

First report of this commission, which is a consolidation of the former Harbor and Land Commission of Massachusetts and the Directors of the Port of Boston.

MONTREAL AQUEDUCT: Comments by the Committee of the Ratepaying Engineers on the report on Aqueduct Enlargement, Montreal Water-Works, by the Board of Engineers—Montreal, Que.: Walter J. Francis (260 James St.), Secretary Committee. Paper; 6 x 9 in.; pp. 87.

PERMISSIBLE EXPLOSIVES: Tested Prior to Jan. 1, 1917—By Spencer P. Howell. Washington: Bureau of Mines. Paper; 6 x 9 in.; pp. 19.

PROBLEMS OF ST. LOUIS: Being a Description, from the City-Planning Standpoint, of Past and Present Tendencies of Growth with General Suggestions for Impending Issues and Necessary Future Improvements. The City Plan Commission, St. Louis, Mo.—By Harland Bartholomew, Engineer. St. Louis: The Commission. Paper; 6 x 9 in.; pp. 140; illustrated.

PURIFICATION OF TANNERY WASTES—By Harry B. Hommon, Sanitary Chemist, United States Public Health Service, Cincinnati, Ohio. Reprinted from "Journal of American Leather Association," July, 1917. Address the author. Paper; 6 x 9 in.; pp. 320.

Description and summary of results of tests at Luray, Va., and Cincinnati, and description of a permanent working-scale unit at Luray.

TUBE MILLING—By Algernon Del Mar. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 159. $2.

Although this book is intended to describe the application of the tube mill to metallurgical problems, the occasional use of such mills in other types of engineering work, notably in cement manufacture, may make it of interest to some readers of this journal.

UNITED STATES ARTILLERY AMMUNITION: 3- to 6-in. Shrapnel Shells, 3- to 6-in. High Explosive Shells and Thin Cartridge Cases—By Ethan Viall, M. Am. Soc. M. E., Managing Editor "American Machinist." New York: McGraw-Hill Book Co. Cloth; 9 x 12 in.; pp. 98; 171 illustrations. $2.

A reprint of a series of highly detailed, profusely illustrated articles from the journal named above.

USE OF MEAN SEA LEVEL AS THE DATUM FOR ELEVATIONS—By E. Lester Jones. Superintendent United States Coast and Geodetic Survey, Washington, D. C. Paper; 6 x 9 in.; pp. 21. From Superintendent of Documents, 5 cents.

WAR INVENTIONS: A Survey of the Laws Relating to the Adoption of Inventions by the United States and Allied Governments, and Methods of Submitting Inventions of Military or Naval Value to the United States and Allied Governments—By Lawrence Langner. New York: The Author, 55 Liberty St. Paper; 5 x 8 in.; pp. 15. 25 cents.

CONCRETE ROADS: Report on the Present Position and Possible Future of Concrete Roads in this Country—By H. Percy Bounois, M. Inst. C. E. Westminster, England: Roads Improvement Association (15 Dartmouth St.). Paper; 5 x 8 in.; pp. 32. Sixpence.

THE TESTING OF ROAD OILS: Including Character of Oils and Methods of Examination—By F. L. Roman, Testing Engineer, Illinois State Highway Department, Springfield. Paper; 6 x 9 in.; pp. 29; illustrated.

THE SEASONING OF WOOD—By Harold S. Betts, in charge, Office of Industrial Investigations, United States Forest Service. Paper; 6 x 9 in.; pp. 28; illustrated. 10c. from Superintendent of Documents, Washington, D. C.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Sidewalks Flushed Over Tops of Parked Automobiles

THE DOWNTOWN sidewalks as well as the streets in Chicago are flushed every night by the Citizens Street Cleaning Bureau. To expedite the sidewalk work, there has recently been added to one of two tank

EXTENSION PIPE WHEN NOT IN USE FOLDS OVER TOP OF TANK

trucks a pipe extension to clear parked automobiles. It is connected to the discharge line from the pump with a stuffing-box joint and has a knee brace of the same 2½-in. pipe as the remainder of the line. A single outfit can flush the whole 72,000 sq.yd. of area in the territory covered in an 8-hour night at a cost of 20c. per 1000 sq.yd. It is usual, however, to let the two trucks work at the job, although from the second one the hose must be dragged behind vehicles near the curb. The remainder of the night's work is to flush the 120,000 sq.yd. of pavement. The fan nozzle is 6 in. wide and delivers a stream ½ in. thick. It is played toward the

PARKED AUTOMOBILES ARE NOT DISTURBED BY SIDEWALK FLUSHER

gutter and carries the dirt and surplus water ahead of it. No complaint of damage to walks or calking has been made.

When the second tank is equipped, the connection will be made near the front of the tank, so that there will be no danger of bending the pipe, should the truck run it into something when half-way extended.

The attachment was devised under the direction of Richard T. Fox, general manager of the Citizens Street Cleaning Bureau, by J. W. Ingels, superintendent.

Spokane Installs Low-Cost Street Signs

SIMPLE, legible, low-cost street signs are being installed in Spokane, Wash., as shown by the accompanying illustration. Each sign consists of two enameled porcelain plates secured to a creosoted wood base and held by a bracket, clamped to a lamp post. The wood base is so shaped as to make each nameplate rest at a slight angle with the vertical, so the street light from above casts no shadow on the nameplate. Each of the four plates attached to one lamp post costs $0.35, and the two brackets together cost $1.15, making a total cost of $2.55 for plates and brackets at a given corner. The cost of the wood and of erection is small. The signs were designed by Morton MacCartney, city engineer of Spokane.

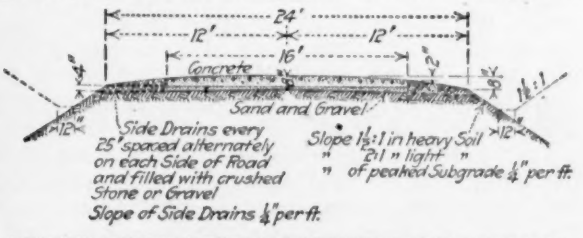
SPOKANE USING STREET SIGNS LIKE THIS

Peaked Subgrade Provides a More Certain Underdrainage

BY D. M. BELYEA

County Highway Engineer, St. Claire County, Mich.

A CONCRETE or brick slab laid with a flat bottom upon a flat subgrade affords no possibility for underdrainage. As a result, seepage through the pavement at various points—such as expansion joints, along car rails, and through semiporous spots—keeps the subgrade moist and affords a good chance for frost upheavals with the resultant cracking of the rigid surface. While there is but slight importance attached to such seepage if the construction is on a sandy or porous soil,


24'
12'
12'
16'
Concrete
Sand and Gravel
12"
12"
Side Drains every 25' spaced alternately on each Side of Road and filled with crushed Stone or Gravel
Slope of Side Drains ¼" per ft.
Slope 1½:1 in heavy Soil
" 2:1 " light "
" of peaked Subgrade ¼" per ft.

PEAKED SUBGRADE BROUGHT LEVEL WITH SAND OR GRAVEL AFFORDS BEST POSSIBLE DRAINAGE

a clay or heavy soil brings about conditions which cannot be disregarded.

The ordinary precaution of laying a slab with a crowned bottom upon a crowned subgrade does not entirely alleviate these conditions, as the slab is laid directly upon the heavy soil, filling every crevice and blocking a free movement of the water from under the crust. The newer specifications, which require 2 or 3 in. of sand to be laid upon the flat subgrade, and upon this sand bed to lay a flat-bottomed slab, are undoubtedly an improvement, but it is questionable whether this method will prove to be entirely sufficient.

The writer is of the opinion that the subgrade should not be crowned, but peaked, as indicated in the illustration. On this a sand covering about 2 or 3 in. in thickness at the center can be well rolled to a flat surface. This will allow a free movement of the water between the bottom of the slab and the top of the impervious subgrade and should afford adequate protection against the troubles outlined in the foregoing.

Use Steam Jet To Clear Coagulant Lime

STEAM jets replace water injectors occasionally on the coagulant lines at the filtration plant in Evanston, Ill. As designed, the coagulant, after passing the orifice boxes, is forced by water ejectors 450 ft. through a 2-in. lead pipe to the point of application. Considerable trouble from the alum line clogging was experienced, until a year ago the commissioner of public works, I. S. Brower, had the steam connection made. After using steam for 15 or 20 min., coagulant is forced through the pipe in the usual manner with water. This cools the inside of the pipe rapidly, causing the scale to break away. Prior to this practice it was necessary to clean the steam line once a week. Once in two months is the interval of time since using the steam jet.

Limited Tests Show Effect of Hydrated Lime on Strength of Concrete

THE Bureau of Standards some time ago started an exhaustive series of tests looking into the effect of hydrated lime on concrete, as regards strength, consistency, watertightness and workability. A preliminary announcement by Warren E. Ensley and S. K. Kaczorowski, of the bureau, gives some conclusions, based on six months' tests, as to the effect on strength. The authors say that the results should be used with caution and are true only of hand-mixed, tamped concrete, of rather dry consistency and stored in a damp closet. There is no evidence at present to show the effect of the hydrate on concrete which is either machine mixed, poured or aged in air, and interpretation of the present conclusion to obtain such information is not justifiable.

The conclusions now made are: (1) The substitution of hydrated lime for cement causes, in general, a diminution of the compressive strength of the concrete. This is most pronounced with 1:2:4 concrete. (2) Hydrated lime causes a less diminution of strength in a 1:1½:3 concrete than in a 1:2:4. Results indicate that the sizing of the ingredients may be one of the important factors in determining the value of hydrated lime in concrete. (3) At least up to six months, there is no appreciable difference in behavior between high calcium and high magnesian hydrate. (4) The diminution of strength caused by hydrate when 1:1½:3 concrete is stored in air is not nearly so great as when the concrete is stored in the damp closet.

Large-Size Speedometer Pointer Shows Bad Places in Road

ON A ROAD in Occidental Negros, Philippine Islands, bad turns or grades are indicated by a novel roadside sign which simulates on a large scale the pointer of a speedometer. Indicated speeds are measures of the comparative danger of the road section to be approached. The view is reproduced from the *Bulletin* of the Philippine Bureau of Public Works.

SIGN TELLS PHILIPPINE TOURISTS WHERE SLOW SPEED IS DESIRABLE

Proposes New Overbreakage Payment Rule in Thorough-Cut Excavation

BY A. B. B. HARRIS
Civil Engineer, Chicago

IF, IN railroad thorough-cut construction, the solid rock excavation be divided into two classes, (1) material within the slopes, (2) breakage, and if prices be fixed on both classes, the price on the latter (breakage) being sufficient to reimburse the contractor for handling this material but not large enough to warrant the excessive use of explosives, the result should be beneficial to both parties to the contract.

The railroad company will pay no more for the breakage than it is worth in the embankment, and the contractor can use enough powder to break the rock to the slopes, thus avoiding expensive trimming, without being up against the judgment of the engineer as to whether or not he will be paid for the material outside of the slopes.

This "in the judgment of the engineer" clause about the use of powder and breakage often leads to two bad results: First, loose stones are left hanging to the side of the cut, which should be taken down under construction, but are not and consequently have to be removed under operation. They frequently fall on the roadway and sometimes cause a serious wreck. Second, expensive controversies which may lead to more expensive lawsuits are the logical outcome of this "in the judgment of the engineer" clause.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Ohio Contractor Finds Trucks Indispensable on Road Work

SEIPLE & WOLF, contractors of Mahoning County, Ohio, state that had it not been for their fleet of 6 motor trucks, it would have been impossible to carry out the season's road work. Teams have been practically unprocurable at any price and sole reliance has been placed upon motor trucks.

After a number of years' experience and experiments, this firm has returned to the 5-ton truck. For a time 2½- and 3-ton trucks were bought, but it is now claimed that the larger truck is more economical, providing the roads are passable for it. The loading and operating costs, it is said, are but slightly different, and the larger load makes the 5-ton truck more economical.

This firm does not favor the use of trailers on ordinary road construction jobs because of the difficulty in handling them at the terminals. These opinions are based on the use of motor trucks for short hauls, that is, not over six or seven miles, or the service for which teams have been used a great deal up to the present time. The county authorities, on the other hand, own two 3½-ton road trucks and use three trailer dump-wagons to a truck and they consider the combination desirable.

Special Gang Does Fast Work in Laying Brick Pavement

FROM 800 to 1000 ft. of 16-ft. monolithic brick pavement a day is "going some," yet one contractor has found a way to do it. He is C. F. Green, of Marion, Ind., who has gotten together a fairly permanent gang of about twelve men who specialize in laying, rolling and grouting brick for the monolithic and cement-sand cushion types of brick pavement.

With this gang he takes subcontracts for that part of the work. The principal contractor lays the concrete foundation and the subcontractor follows as closely as working conditions will permit with the bricklaying. The subcontractor takes all the risk of delays to the concreting plant. Nevertheless, the scheme has worked out very well and both contractors appear to be profiting by it.

The two principal men of the gang, who can lay brick about as fast as it is possible to lay them, get 50 cents an hour, and the subcontractor is constantly on the job to see that the rest of the gang get the brick to them. A Mathews gravity conveyor helps in supplying them. The grouting is done by a process which makes for speed, if possibly not for the best joints. The grout is mixed in a large, square, two-wheel, flat-bottom trough or pan in one-bag batches. Two men with hoes do the mixing, and then the grout box is turned on end and the entire batch allowed to run out over the pavement where a single man with a 4-ft. squeegee does the spreading.

Steel Tanks Fabricated, Shipped and Erected in 30 Days

THE RECENT completion in record time of two 100,000-gal. elevated steel tanks 60 ft. high at Fort Oglethorpe, Ga., for the reserve officers' training camp in Chickamauga Park was made possible by standardizing the shop work, riding the shipments, and by

CONVEYOR AND TRAINED GANG FEED BRICK TO TWO EXPERT LAYERS AT HIGH SPEED

MADE, SHIPPED 1000 MILES AND ERECTED—IN 30 DAYS

hard work on the part of the erection force. On May 16 the contract for these water towers, including the foundations, was awarded by the War Department. On June 14, 30 days later, both tanks were filled with water from the mains of the Chattanooga Water Co. and placed in service as an addition to the existing system, which consisted of one 200,000-gal. steel tank supplied with water pumped from wells.

Standardization of the details of these structures in the drawing room and shop made possible the shipment of the fabricated material within seven days after the receipt of the order, on May 23. The cars were labeled with the cards provided by the Quartermaster Department indicating that the shipment was government war material, and railroad officials were notified that it should not be delayed in transit. In addition to this, a traffic man rode the cars as far as Cincinnati where they were transferred to the Southern Ry. and routed to Chattanooga. From here they were shipped over the Central Railroad of Georgia to their destination, a siding three-quarters of a mile from the site in Chickamauga Park, arriving May 28.

Work on the foundations had meanwhile been rushed to completion. This included about 180 yd. of earth excavation and the placing of 90 yd. of concrete, all the materials for which had to be trucked about 11 miles from Chattanooga.

On Monday, May 28, the unloading of the steel from the cars was started and tools and equipment were transported to the site, where erection was begun at once. During this week, with one day out for rain, one tower, the bottom and six first ring sheets of one tank were erected and work on the second tower was started. This erection was greatly facilitated by the use of a gasoline hoisting engine. A portable gasoline compressed-air outfit was also set up and when the riveting started it was possible to keep four crews going on the two towers.

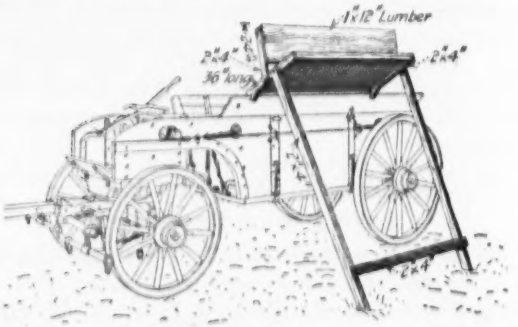
With the work already well organized, the force was doubled on June 4 by the addition of a crew of seven men and a foreman. Very satisfactory progress was reported, and with the exception of one rainy day, nothing was experienced to seriously hold up the schedule. On June 12 the tanks were connected to a 12-in. main of the Chattanooga Water Co., and on June 14 they were filled with water and ready for service.

Complete coöperation on the part of the officials in charge and long, hard shifts by the men in the field accomplished much to assure the successful completion of these structures within the required time. Capt. A. T. Dalton as acting quartermaster was in charge for the Government. Fred Palm handled the job in the field for the Pittsburgh-Des Moines Steel Co.

Target Improves Wagon-Side Screen

By F. M. Hough
Superintendent of Construction, U. S. Reclamation Service, El Paso, Texas

Referring to the wagon-side screen described by Donald A. Thomas in *Engineering News-Record* of July 19, p. 137, I would like to suggest the addition of a



TARGET OBVIATES THROWING GRAVEL ACROSS WAGON

target on the screen, as shown on the attached sketch. This does away with having to throw material across the wagon, and so keeps the material cleaner and lightens the labor. I have used this device with considerable saving in cost over screening on the ground

Pool Floor Built with Forms Slotted for Water Stops

By Richard R. Bradbury
East Pleasantville, N. Y.

Forms slotted to hold the water stops between adjoining floor blocks were required in laying the floor of a large pool which forms one of the architectural adornments of the Kensico dam of the New York City water supply. This pool, which is 720 ft. long and 135 ft. wide, is partly in cut and partly on a rolled earth fill. It is surrounded by a wall 5 ft. thick, surmounted by cut-stone curbing, and its 8-in. concrete floor is laid on porous material with vitrified pipe underdrains. It was essential to make this floor as near watertight as possible. The floor was laid off in 9-ft. squares with a joint and water stop between adjacent squares.

One of the double-derrick travelers previously used in placing large stones in the dam was mounted facing

west on a track running east and west through the center of the pool. A service track coming in from the east end was laid north of this traveler track. Work was started by building the west end wall and carried east. Wall, cut-stone curb, piping, porous sub-foundation and concrete floor were all built together, the traveler leaving a completed structure behind it.

Forms for the floor slabs were made in the carpenter shop from 6 x 8-in. timbers. A longitudinal groove cut along one side of each of these timbers midway between the top and bottom provided a setting for the steel water-stop strip to be embedded in each block. Each of these form pieces was made separate, and a number of different lengths ranging from a little less than 9 ft. to about 9 ft. 11 in. were turned out, as the progress of the work required the form strips to be used sometimes between blocks already cast and sometimes to overlap adjacent blocks. Forms were first set for alternate blocks in each direction, and when these blocks were concreted and the forms removed this left water-stop strips embedded in the first blocks on both sides of the intermediate blocks in each direction. These could then be filled in, leaving holes in alternate rows in each direction on all sides of which the water-stop strip would be sticking out.

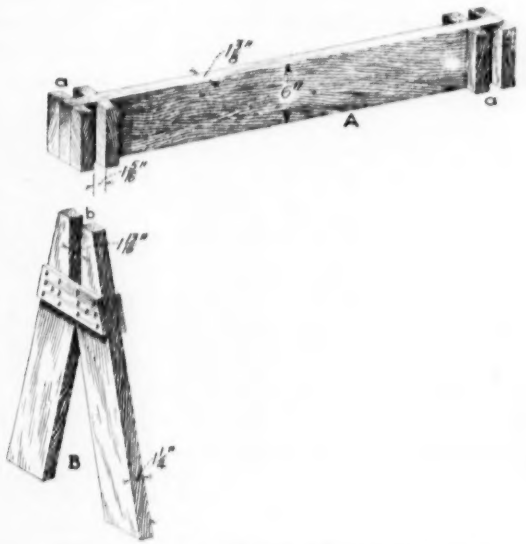
As used for the first blocks, the four sides of a form were clamped in place by clips with set screws just outside the forms at the corners. These screws gripped the water-stop strips, which were laid in long lengths, gridiron fashion, over the foundation before the first of the forms were set. The forms were wedged together by driving steel or wood wedges between the clips outside of the forms. Altogether about 350 form pieces were made, and as a rule about thirty blocks were formed with them at one time. The same pieces were used continuously throughout the work, and most of them lasted the job in good shape.

The work was done for the Board of Water Supply of New York City by H. S. Kerbaugh & Co., Inc.

Handy Trestle Easy To Move and Store

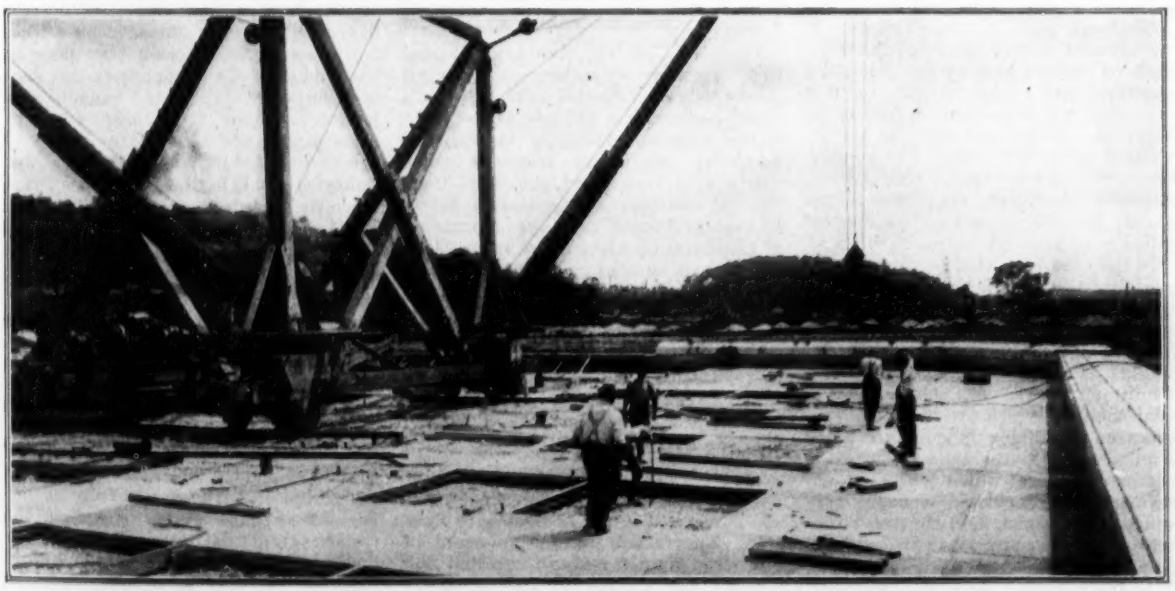
By Ernest Schwartz
Brooklyn, N. Y.

THE SKETCH shows a trestle which may be readily taken down and stored in small space and without danger of breakage. The top bar is provided with



TRESTLE OCCUPIES LITTLE SPACE WHEN KNOCKED DOWN

grooves at each end formed by nailing strips of wood on each side to a bare clearance for the upper ends of the legs. The legs are framed with a slot at the top which is a close fit for the top bar. This trestle, which has been found useful in shop practice, might prove economical on building construction, as the ordinary trestle is certainly difficult to store, besides deteriorating rapidly as a result of handling from place to place.



ALL WORK COMPLETED AS TRAVELER MOVED BACKWARD—LONG WATER-STOP STRIPS PASSED THROUGH FORMS AND HELD IN PLACE WHILE ALTERNATE BLOCKS WERE CONCRETED

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

French Officer Discusses Engineer's Part in War

Captain Capart, of General Petain's Staff Tells of Selection of Consulting Engineers as Members of the General Staff

Consulting engineers are now being regularly appointed as members of the General Staff of the French Armies. This fact, significant of the appreciation in which technical advice is held, was stated during a recent interview between *Engineering News-Record's* representative and Capt. Gustave P. Capart, who is in the United States on a mission for the French Government as a member of the staff of General Petain. Captain Capart, during his period of active service on the Western front, had an opportunity of observing in detail the industrial and engineering operations demanded by modern warfare.

Transportation Varied

"This war," said Captain Capart, "is a problem of material, roads and transportation. The applications of means of transport are numerous and varied. There have been adopted progressively all of the systems which are known to the engineer; narrow-gage railways have become of very common usage. Cableways and telpherage systems have given extraordinarily valuable service on the front. One installation of this kind has permitted us to effect an economy of 600 mules per day at one point on the French front, and the Italian army employs similar installations with continued success. The motor truck plays a rôle which day by day becomes more important; the thousands of drivers and mechanicians and repairmen have, little by little, come to constitute an important organism of the army. Mechanical services are developing more and more. The employment of compressors, rock drills, trenching machines, etc., has tended to call for an increasing number of skilled workmen for these machines.

"In the zone evacuated by the enemy," according to Captain Capart, "there is an immense amount of restoration to be undertaken and we must be able to utilize a skilled personnel for the rebuilding of bridges and the construction of military works. The construction of great shelters, which are in reality subterranean buildings, is confided today to units which are as skilled as are the contractors' forces which construct subways in New York and who not only excavate but timber and construct concrete work, etc., and leave the shelters complete.

"In the engineer corps, specialization is too well known to call for special reference. Mining, bridge construction, trenching operations are today all works requiring special units. The military instructions of specialized regiments may be extremely limited and numerous regiments may be made ready in a very short period of time. The Government of the United States has comprehended fully the importance of organization along these lines. It is of common knowledge that the expedition of specialized regiments responds to urgent military needs, and it reflects one of the aptitudes of this country where you pass so rapidly from project to realization. But it is also desirable that it be known that we are very anxious to learn more of the American methods of work."

Officer of General Petain's Staff in United States on Mission for French Government

CAPTAIN G. CAPART

Industry After the War

The specialized American troops who are going to France, according to Captain Capart, will be the pioneers of American industry over there and will prepare the ground for the economic war which will be waged against the Central Powers tomorrow. A flow of business between America and her allies, he believes, should be the result of the present coöperation. In French industries American-made machines will replace those of German make.

"It must not be forgotten," Captain Capart concluded, "that the services of the troops in the rear are fully as important as those of the troops in the trenches, and that the soldier who lays track or who repairs a power line is fulfilling his duty as a soldier just as does the man who carries a rifle.

Government Barges Bring Coal to St. Paul

Fleet Carried 3100 Tons and Was Two Weeks in Transit—Equal to a 60-Car Train

On Aug. 12 the United States steamer "Nokomis" brought into St. Paul, Minn., six barges of Illinois coal which left St. Louis on July 30. This was an experimental trip up the Mississippi made under Federal auspices to test the possibilities of river transportation of coal. The Northern cities have been suffering from coal famine, largely due to the congestion on the railways, so the Government lent the use of six steel barges, the steamer and the crew of 35 men. Costs of the trip were carefully kept and are to be reported to the Secretary of War for study.

The tow was 530 ft. long, 105 ft. wide and drew 5 ft. of water. The 14-day trip comprised two days' delay for lack of pilot through the Rock Island rapids, 12 hours' delay from fog and 12 hours for repairs. The fleet started with 3100 tons of coal and 500 tons were burned on the trip, so that the delivery was 2600 tons—equal to a 60-car train.

At St. Paul the municipal coal- and ore-handling scheme reported some weeks ago has been changed so that only temporary handling structures will be built this year. The coal docks are on the municipally owned levee at the foot of Market St., about two miles upstream from the Terminal Bridge. They consist of a double-track unloading trestle built inside of and parallel to the harbor line along which coal barges stand to be unloaded by a locomotive crane, on a temporary floor on the land side. The capacity of this floor is 2500 tons. Cars and wagons are loaded out from this stockpile by the same means and switched or hauled to the various industries of the city. The unloaded coal barges will then drop down the river two miles to the Terminal Bridge and be loaded with iron ore for their trip south, from hoppers built into the floor of the bridge.

Engineer Corps Puts Premium on Efficiency

New Provisions for Mississippi Levee Work Give Contractor Half of Saving on Bid Field Cost

Due to the unusual conditions now prevailing, the Corps of Engineers, U. S. Army, will use a form of cost-plus-fee-plus-saving contract for Mississippi flood protection work which is expected to result in more economical and efficient work, and at the same time to prevent work being thrown into bankruptcy by unforeseen conditions. It is proposed to let the work on the basis of field cost to the contractor plus certain additional sums. Bidders will therefore state the outfit which they will place upon the work and the field cost per cubic yard for which they will undertake to do the work, subject to the following conditions:

1. That the contractor will furnish and place upon the work a complete outfit as stated in his proposal, and all labor and supplies necessary for its operation.

2. That the United States may at its discretion secure on such terms as it may be able to obtain any plant necessary to keep the contractor's outfit up to the strength agreed upon, or any supplies necessary for the efficient operation of the plant which the contractor may fail to provide, and may deduct the cost of such plant or supplies from any amounts due the contractor under paragraphs 5, 6 and 7 below.

3. That the contractor will actually operate his outfit at the expense of the United Sates.

4. That the United States will keep an account of all expenses incurred in operation and allow the amount of the same in estimates, but no allowance will be made for getting the outfit on the job or away from it.

5. That the United States will pay the contractor 25% over and above the price for which he undertook to do the work, provided the actual cost as determined and paid by the United States does not exceed the price bid.

6. That if the contractor performs his work for less than the amount stated in his bid, the United States will pay him in addition to the 25% specified in the preceding paragraph, one-half of the difference betwen actual field cost as determined by the United States, and the price stated in the bid.

7. That if the field cost exceeds that stated by the contractor in his proposal, the excess cost up to and including 10% of the cost stated in the proposal shall be deducted from amounts to be paid in accordance with paragraph 5.

8. That the United States reserves the right to require replacement of any piece of plant not considered suitable for the work to be done at the expense of the contractor; it being contemplated that only ordinary repairs to plant will be allowed in determining the cost.

The accompanying table shows what would happen under this contract in different cases, assuming a bid of 20c. a yard to have been successful on a 500,000-yd. levee contract. It is evident that up to the point where the work exceeds the estimate by 10%, there is every incentive to the contractor to save money. Unless unusual conditions, such as a great rise in the cost of labor, should occur, this is hardly expected to occur. It is pointed out that the form of contract will discourage abnormally low bids, and also discourage the contractor who lacks plant or experience, since any expense incurred at the order of the Government in improving his plant or methods must come out of his fee.

EXAMPLE SHOWS HOW NEW MISSISSIPPI LEVEE CONTRACT WILL OPERATE

	Work Done for Bid Price		Work Costs Less than Bid		Work Costs More Than Bid	
Field cost of work		$100,000		$80,000		$120,000
Contractor's fee, 25% of bid price	$25,000		$25,000		$25,000	
Contractor's half of total saving			10,000			
Contractor's loss, 10% of bid					10,000	
Contractor's total compensation		25,000		35,000		15,000
Total cost to Government		$125,000		$115,000		$135,000

Atlanta May Have Gravity Water-Supply

The City Council of Atlanta has unanimously adopted a resolution introduced by Councilman Jonas H. Ewing which provides for an investigation of the possibilities of a gravity water-supply through a 60-mile conduit. A hydro-electric plant is included in the project. The investigating committee comprises the superintendent of waterworks, the city electrical engineer, three members of the city board of consulting engineers, three members of the City Council and the mayor.

Union Gap Dam on Wapato Project Cost $144,264

The Government dam at Union Gap, near North Yakima, Wash., just completed by the United States Indian Reclamation Service, cost $144,264 according to the report of L. M. Holt, superintendent. The dam contains 7271 cu.yd. of concrete, the total length of the concrete sections is 620 ft. and of earth and riprap sections 1340 ft. The estimate for the concrete and reinforcement was $10 per cu.yd. and the actual cost was $9.65 per cu.yd. The dam contains the headgate of the Wapato Canal and is the first item of the permanent improvement which will lead to reclaiming an additional 70,000 acres on the Wapato project.

War Demand Deprives Vancouver of Much Needed Pipe

As a result of the Federal Government commandeering all water pipe, both wooden and steel, for war purposes, the improvements to the Vancouver water system, including the new 18-in. pipe line from the springs at Ellsworth, are at a standstill. The North Coast Power Co., which owns the local system, had contracted for all the pipe and was securing regular deliveries when the Federal order prevented further application of pipe to private contracts. About 4000 ft. of pipe is needed before the new line can be put into use.

The condition of the old pipe line is very poor, and owing to the demands made on the local system by new industries the shortage of pipe creates an emergency. Efforts are being made to have the Federal order altered.

All Men Asked To Register for War Service

Department of Labor Compiling United States Public Service Reserve List for War Work

The United States Department of Labor has organized the United States Public Service Reserve as a means of putting on record for ready access a list of all adult males who desire to find their place for effective service to the country in the war emergency and to make it easy for the Government to locate them when it needs help from men of their capacities. Blanks to fill out with the individual's qualifications are obtainable from the department at Washington, and when filled out are to be classified and filed there for reference. It will, therefore, form an official and, it is hoped, comprehensive substitute for the many isolated censuses which have been made by different organizations and which for the most part have done little else than to swell the archives of the organization itself.

The purpose of the Reserve is announced to be "to enable those who are not called into the army or navy to play their part in realizing the ideal of a whole nation organized to war for the safety of our country and the preservation of the civilization and the future peace of the world. It is a common meeting ground where men of all degrees of capacity and attainment may unite in devoting themselves to the service of our country and mankind."

Registrants in the Reserve will be given a button to wear. They will be under call for the specific kind of service for which they claim fitness, but are under no obligation to accept any particular call.

New Jersey Sues To Recover Riparian Lands

The New Jersey State Board of Commerce and Navigation has decided to institute 1600 suits to recover for the state riparian land alleged to be held illegally in various sections. The holdings represent various sized claims, but it is estimated that their value may reach $1,000,000. Among the defendants will be the Florence Iron Works on the Delaware River and the Pennsylvania Railroad Co. for the bridge it erected across the Hackensack River.

Engineering Council Active in Many Fields

Three Standing Committees Appointed—Special Attention To Be Given to War Inventions

Subsequent to the organization meeting held on June 27, 1917, the Engineering Council has held two other meetings, one on July 13 and on July 26. There have been appointed standing committees as follows:

1. On Public Affairs, comprising C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice, Jr.

2. On Rules, comprising J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus.

3. On Finance, comprising B. B. Thayer, I. E. Moultrop, Calvert Townley and Alexander C. Humphreys.

Many matters coming before the council, both from the several founder societies and from the council's predecessor, the Joint Conference Committee of National Engineering Societies, have been considered.

The council has also created a War Inventions Committee comprising H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to coöperate with the Naval Advisory Board and other departments at Washington if desired in the promulgation to engineers of war problems now before the Government and for which there are opportunities for solution by means of inventions. It also created a committee comprising George J. Foran, E. B. Sturgis, A. S. McAllister and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable the committee to coöperate with the different departments of the Federal Government on request and to assist in supplying the Government's need for engineering services.

While the council comprises only members from the four founder societies, and of course can claim no right to speak for members of other societies nor for engineers at large, the council members feel that the body will not have accomplished the results for which it was created unless it early establishes means of cordial coöperation with engineers, organized or otherwise. Every effort toward this end is contemplated.

Reclamation of Arid Lands

The Reclamation Service of the Department of the Interior has recently sent out an invitation to individuals, citizens' associations, farmers' clubs and large landowners asking them to notify the department of any arid lands capable of development. Complete information is requested as to location, character and topography of the land, nearest source of water-supply, suggested methods of irrigating same, with approximate cost, probable number of users and any other data that might have a bearing on the subject. The department promises to facilitate quick action on promising projects.

Niagara Power Companies Divert Water in Excess of Permits

A committee of engineers, who have been investigating the use of Niagara River water by private power companies for the past few months, have reported to the Ontario Hydro-Electric Commission that there is and has been for some time an unauthorized diversion of water by the Electrical Development Co. and the Canadian Niagara Power Co. The amounts are considerably in excess of that which is permitted these companies to use for power development under their agreement with the Queen Victoria Park Commission. The Ontario Power Co., recently acquired by the Hydro-Electric Commission, is also found to have been using more water than authorized.

As a result of this report the Ontario Government has appointed a commission consisting of three High Court judges, Chief Justice Sir William Meredith and Justices Kelley and Sutherland, to investigate the practices of power development companies using provincial water for hydro-electric purposes. The commission has authority to set a price to be paid by any company for power taken beyond their limits.

Making Oregon Irrigation Bonds Attractive

The first application for the certification of bonds under the new Oregon district law has been made by the Payette-Oregon Slope Irrigation District. This project covers about 6000 acres of land along the Snake River in Malheur County, where the water is lifted by eight motor-driven centrifugal pumps and distributed in three levels of canals. The works are complete and about 75% of the land is under irrigation. Power is secured from the main line of the Idaho-Oregon Power Co. The project has been in successful operation for several years, and the Supreme Court has passed on the legality of proceedings leading to the original bond issue. The assets for the district are estimated to exceed $700,000 and the bonds asked to be certified amount to $225,000.

The new statute provides that irrigation district bonds may be certified by a board (the Irrigation Securities Commission, composed of the State Engineer, the Superintendent of Banks and the Attorney General) when the assets of the district are at least double the amount of bonds to be certified. Certified bonds are legal investments of all trust funds. The law was designed to separate gilt-edged irrigation bonds from those of a questionable nature or those depending for security on a satisfactory completion of a project.

New Jersey Sells No More Riparian Rights

The New Jersey Board of Commerce and Navigation has announced that it will sell no more riparian rights, but will execute long-term leases where waterfront holdings are desired.

Engineers Become General Officers in Army

Three Brigadiers and Seven Colonels from Corps of Engineers Promoted August 14

In the list of new major generals and brigadier generals in the National Army sent to the Senate by the President on Aug. 14 are the names of a number of former and present members of the Corps of Engineers. There are three new major generals: Harry F. Hodges, who was promoted to a brigadier of the line after his service at Panama; John Biddle, recently superintendent at West Point and since the beginning of the war promoted to a brigadier of the line; and Joseph E. Kuhn, head of the War College and, following a long period as observer at the front, recently made a brigadier.

The new brigadiers who were all colonels in the Engineer Corps are: Mason M. Patrick, Edward Burr, William C. Langfitt, Harry Taylor, Henry Jervey, Charles H. McKinstry and William V. Judson.

Chicago Sanitary District Adopts Budget

The Sanitary District of Chicago on July 23 adopted a budget of appropriations for the calendar year 1917 totaling $13,413,435. This is distributed among departments as follows: Engineering, $8,869,411; Illinois and Michigan Canal and Illinois River, $33,027; Law, Treasury, Real Estate, Police, and Board and Clerk of District, $3,264,336; Electricity, $1,273,660. The appropriation for the Department of Engineering includes $509,665 for salaries and wages and $6,440,920 for structures and improvements. In this latter item are $3,033,370 for channels, ditches, reservoirs and docks; $2,331,900 for sewers, tunnels and sewage purification structures; $722,850 for bridges and viaducts; $54,300 for paving and railway work, and $15,000 for locks, dams, breakwaters and cuts. Charles H. Sergel is president of the board of trustees; George M. Wisner is chief engineer.

Oregon Now Has Much Road Work on Hand

Counting road construction, bridge building and other work turned over to the highway commission by the various counties of the state for overseeing, the Oregon State Highway Commission has on hand work aggregating the sum of $2,200,000, which is nearly as much as the commission has done since its organization in 1913.

There is now under way or in proposals called for an aggregate of work in excess of $1,600,000. On July 6 the commission went to Portland to open bids on five jobs on the Columbia River highway in Columbia and Hood River Counties. This work amounts to about four hundred thousand dollars.

PERSONAL NOTES

LOREN T. PLUMMER is at present engaged on Government work at the new cantonment at Wrightstown.

R. E. VAN HORN, formerly connected with the Bureau of Sewage Design, Dayton, Ohio, has accepted a position with the Coventry Land and Improvement Co., of Akron, Ohio, as assistant engineer on municipal and allotment work, including the paving of all streets and the laying of sewers, water mains and cement sidewalks for a new development of about one mile square.

THOMAS B. POWELL, formerly of Powell & Clark, civil and mining engineers, will continue his private practice under his own name. J. P. CLARKE resigned from the firm to take care of personal business affairs in South Carolina.

GEORGE C. WENDLING has been promoted to assistant engineer in charge of the engineering work on the Nashville Division of the Louisville & Nashville R.R., with headquarters at Nashville.

FRANK R. DAVIS, formerly with the Rapid Transit Subway Construction Co. as assistant engineer, has recently become connected with the designing department of the Bureau of Yards and Docks, Washington, District of Columbia.

MAX J. WELCH recently returned from Peru, South America, and has accepted the position of chief draftsman during the construction of the new Traylor shipbuilding plant at Cornwells, Pennsylvania.

ARTHUR L. SHUMWAY, city engineer of Camas, Wash., has been assigned to the Tenth Engineers for immediate service in France.

R. M. COOMER, of the engineering and contracting firm of Coomer & Small, Sioux City, Iowa, has been commissioned as captain in the Engineer Officers' Reserve Corps and has been detailed for immediate duty in France.

ARTHUR LEDERER, formerly with the Sanitary District of Chicago, has been appointed director of the State Hygienic Laboratory of West Virginia, with headquarters at Morgantown.

T. A. OBERHELLMANN, formerly with the Parker-Russell Mining and Manufacturing Co., of St. Louis, is now with the Stacey Manufacturing Co., Cincinnati, engineers and builders of gasholders, tanks and gas-plant equipment.

G. HSI HU, who has been on the engineering staff of the Chicago, Milwaukee & St. Paul Ry., under E. R. WEBSTER, assistant engineer, has resigned to accept a position on the construction of the Chuchow-Chinchow Ry. for the Government of China. This is one of the lines being built by the Siems-Carey Syndicate. Mr. Hu is a graduate of Purdue University.

PROF. MILO F. KETCHUM, dean of the College of Engineering of the University of Colorado, was elected president of the Society for the Promotion of Engineering Education at the recent annual meeting of the society held at Washington, D. C. Professor Ketchum was instructor in civil engineering at the University of Illinois from 1895 to 1897, then becoming bridge and structural engineer for the Gillette-Herzog Manufacturing Co. In 1899 he was appointed assistant professor of civil engineering at the University of Illinois, which position he resigned to become contracting manager of the American Bridge Co., Kansas City, in 1903. In 1904 he became professor of civil engineering and in 1905 dean of the College of Engineering at the University of Colorado. Professor Ketchum was joint author, with Prof. W. D. Pence, of "The Surveying Manual" and sole author of "The Design of Steel Mill Buildings and the Calculation of Stresses in Frame Structures," "The Design of Walls, Bins and Grain Elevators," "The Design of Highway Bridges," "The Design of Mine Structures" and "The Structural Engineers' Handbook."

Elected President of Society for the Promotion of Engineering Education

PROF. MILO F. KETCHUM

BENJAMIN F. CRESSON, JR., consulting engineer of the Board of Commerce and Navigation, is at present in Washington planning oversea terminals for the Government.

E. M. VAIL has been placed in charge of the new offices of the New Jersey State Highway Department recently opened in Plainfield. This office will be headquarters for the Northern Division.

JOHN LAWRENCE MAHER, assistant engineer in the office of the district engineer, maintenance-of-way, northwest district, Baltimore & Ohio Railroad Co., has been commissioned captain in the Engineer Officers' Reserve Corps, U. S. A., and is awaiting instructions from the adjutant general to report.

A. BALDWIN WOOD has been made consulting engineer of the Chicago Sanitary District. He will retain his position with the Sewerage and Water Board of New Orleans.

D. Q. MCCOMB, testing engineer with the Pittsburgh Testing Laboratory, Birmingham, Alabama, has been commissioned as captain, Engineer Officers' Reserve Corps. Mr. McComb was assistant engineer, Bureau of Public Works, Philippine Islands, on the construction and maintenance of highways, reinforced-concrete bridges, schools, etc., from 1910 to 1913, later having charge of all Government engineering work in the Province of La Union until 1915.

F. A. MOLITOR, consulting engineer, New York City, and major in the Engineer Officers' Reserve Corps, has recently been ordered to duty in Washington on the staff of the director general of railways, F. M. FELTON. This office is an adjunct of the Chief of Engineers, U. S. A., and has to do with the military railway and transportation problems in France.

JAY H. KELLER, consulting engineer, Portland, Ore., has been chosen to take the three months' intensive training at Annapolis preparatory to being commissioned in the navy.

H. H. BARTLETT has recently resigned as superintendent of maintenance of the Eastern Washtenaw Good Roads District, Michigan, to accept the position of office engineer in the engineer's office at Highland Park, Mich. Mr. Bartlett was formerly engineer in charge of the sanitary experiment station of the University of Michigan.

MAJ. R. KEITH COMPTON, who was called into the Federal service last Saturday, resigned the chairmanship of the Paving Commission of Baltimore. Major Compton will continue as a member of the commission and also as consulting engineer, having been granted an indefinite leave of absence. FRANK K. DUNCAN, principal assistant engineer of the commission, was placed in charge of outside construction work. Major Compton has been at the head of the commission since its organization in the summer of 1911, having been for a number of years one of the assistant city engineers.

CALEB MILLS SAVILLE has been appointed manager of the Hartford water-works in addition to his duties as chief engineer. This appointment is the result of a recent change in the city ordinances and places under Mr. Saville's direction all matters relating to engineering, construction, extensions, supervision, care and management of the water system. Mr. Saville was for 10 years division engineer on the Metropolitan Water-Works, Massachusetts, and for four years engineer in charge of the Third Division of the Panama Canal—being selected as chief engineer of the Hartford water-works in 1912. Since that time, besides the ordinary work of the department, design and construction of works for the

additional supply of the city has been under way which has cost upwards of $4,000,000 and includes several large dams, reservoirs, pipe lines, tunnels and conduits and filtration plants.

L. M. MITCHELL, who has had charge of the division engineering work for the Milwaukee & St. Louis R.R., has accepted the position as assistant engineer with the Illinois Central R.R., with headquarters in Chicago, working directly under A. L. DAVIS, office engineer.

BUSINESS NOTES

Boston Bank Opens South American Branch

For American manufacturers engaged in or contemplating the sale of their products in South America there is significance in the announcement that the First National Bank of Boston will open a branch at 501 Bartolome Mitre, Bucnos Aires, Argentina. The branch will be under the management of Noel F. Tribe. Inquiries with regard to transacting business between this country and South America are solicited, and may be addressed to the home office at Boston or to the branch.

Smallest Diesel Engine in This Country Installed

What is claimed to be the smallest Diesel engine of American design and manufacture is one which the Fulton Manufacturing Co., of Erie, Penn., has recently shipped to the War Department. It is a 6-cylinder oil engine of the straight Diesel type, but is rated at only 100 hp. The engine is to be used in a dredge tender. The manufacturers claim that the 100-hp. engine can be operated on fuel oil for 40c. an hour as against a cost of about $3 an hour to run a similar powered gasoline engine.

Southern Pine Men Foresee Much Wooden Ship Building

The Southern Pine Association, of New Orleans, foresees an extensive demand for lumber as the result of a conference at Washington early this month between its members and the Federal Shipping Board. Plans were agreed upon tentatively, it is said, for Southern pine mills to cut timbers for approximately 200 ships for the nation's wooden fleet, in addition to the 63 for which the work of supplying lumber has been in progress for some weeks. The reorganized Shipping Board, it is claimed, will push the wooden shipbuilding program to the limit of the mills' ability to supply material. This will be in addition to constructing steel ships.

Southern pine manufacturers see in the plans of Chairman Edward N. Hurley and the members of the Shipping Board the basis for the establishment of a permanent ship, boat and barge building industry for the South, which will continue after the war.

Southern Exporter Comments on After-War Lumber Markets

"There is practically no building going on in Great Britain." This is the statement of E. R. DuMont, a lumber exporter, of New Orleans, who has recently returned to this country after spending seven months abroad. As to the possibility of an enormous demand for lumber after the cessation of hostilities, Mr. DuMont says that the demand will be exceedingly small during the first year of peace, owing to the reorganization of business, both from a financial and labor standpoint. When conditions begin to adjust themselves, however, Mr. DuMont foresees a steady increase in the demand for Southern yellow pine. At first, of course, the demand will be small owing to exceedingly high ocean freight rates.

The immediate wants of the allies on the western front in the way of lumber are now being supplied, it is said, from forests in France. It is estimated that they are cutting about 30,000,000 ft. or more per month.

NOTES FROM MAKERS OF PLANT AND EQUIPMENT

The Dodge Sales and Engineering Co., of Mishawaka, Ind., recently opened a branch warehouse and sales office at 522 First Ave., S. The branch is handling products manufactured exclusively by the Dodge Steel Pulley Corporation, of Oneida, N. Y. Charles N. Weinberg is in charge.

Charles H. Eglee, for many years associated with the management of the Aberthaw Construction Co., has established a contracting business in his own name. The C. H. Eglee Co., contractor, is located at 120 Milk St., Boston.

The Vulcanite Portland Cement Co. has opened an office at 161 Devonshire St., Boston, to serve the steadily increasing New England trade.

The Diamond Power Specialty Co., of Detroit, has established a plant at Detroit devoted exclusively to the production of soot blower units. The units will be made of Insuluminum, a product resulting from a heat-treating process for metals subject to unusual heat conditions. The General Electric Co. has granted to the Diamond Power Specialty Co. the exclusive rights as lessee to the use of this process.

The Ingersoll-Rand Co. announces the election of J. H. Jowett, formerly general sales manager, to the vice presidency of the company. J. D. Albin, formerly assistant general sales manager, has been promoted to general sales manager. Mr. Jowett and Mr. Albin will continue to make their headquarters at the company's New York office, 11 Broadway.

A. S. Lindstrom has been appointed general manager of the Thordarson Electric Manufacturing Co., of Chicago, effective Aug. 1. Mr. Lindstrom was in charge of the Thordarson exhibit in the Palace of Machinery at the San Francisco Exposition and conducted the experiments with the million-volt transformer which were carried on at that time. Since the exposition Mr. Lindstrom has represented the Thordarson company on the Pacific Coast.

The Denny Renton Clay and Coal Co., which has for some years maintained offices in the Bates Building, Portland, Ore., recently moved to the Chamber of Commerce Building.

The Falls Rivet Co., of Kent, Ohio, has taken over the entire plant and business of the Kent Machine Co. The Kent Machine Co. for the past 10 years has built and marketed concrete mixers. Under the new management this line will be continued and other products added from time to time. In the reorganization of the business the following officers have been elected: M. B. Garrison, president; W. S. Kent, vice president; Roy H. Smith, treasurer; Myles E. Ewing, secretary. The business will be operated separately and under the name of the Kent Machine Company.

The T. L. Smith Co. announced that business in its Detroit territory, formerly in the hands of J. A. McCarty, will henceforward be managed by J. W. Dopp & Co., 18 Columbia St., W. Mr. McCarty will continue in his former line of work as an associate of the Dopp company.

The Asbestos Protected Metal Co., of Pittsburgh, announces the temporary closing of its Cincinnati office, due to the fact that E. G. Irwin, Cincinnati manager, has entered the Ohio National Guard.

J. W. Stjernstedt, manager of the Western Engineering Sales Co., of San Francisco, has taken over the Pacific Coast agency for the Thordarson Transformer Co. and will maintain offices in the Rialto Building, San Francisco.

The Rochester Excavating Machinery Co., Inc., has moved its Rochester office to its new factory at Caledonia, N. Y., effective Aug. 1.

The Pulsometer Steam Pump Co., of Irvington, N. J., is making a big addition to its plant and installing new machinery and equipment, according to W. J. Berow, secretary of the company.

The Buff & Buff Manufacturing Co., of Boston, has purchased the plant formerly owned by R. Seelig Co. and will conduct it as an instrument repair shop.

The MacArthur Concrete Pile and Construction Co., Jersey City, N. J., has been incorporated to engage in the construction of foundations and pedestal piles. A. F. and J. H. MacArthur and F. H. Hitchcock, all of New York, are the incorporators.